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CHEMICAL & METALLURGICAL ENGINEERING

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Co-ordinating Chemical Conventions in 1921

AN EXCELLENT suggestion relative to a group of chemical meetings in the fall of 1921 is made by Dr. HERTY in the July issue of the *Journal of Industrial and Engineering Chemistry*. It appears that four events are scheduled in which chemists generally will be interested. The British Society of Chemical Industry will come to this country for the first time in many years. The Canadian Institute of Chemistry, the American Chemical Society and the National Exposition of Chemical Industries will also hold their customary conventions. These events will prove so attractive that many chemists will undoubtedly wish to attend all of them, but will find it impossible to do so unless the meetings are held at approximately the same time.

The suggestion is that the four organizations co-ordinate their plans and hold a two-weeks' meeting—during the Exposition and immediately following. This would give ample time for the programs of the three technical societies and for inspection of the exhibits at the Exposition. More than this, it would give an opportunity to create closer professional relations among British, Canadian and American chemists and would strengthen Anglo-Saxon as well as professional bonds.

Subsequent to the war there was much talk touching on the probable Anglo-Saxon supremacy in world affairs. To such a prospect we have always given hearty assent and have welcomed every opportunity to promote its accomplishment. Consequently in this group of chemical conventions we see an opportunity to forward Anglo-Saxon unity and solidarity as well as chemical knowledge. The Chemical Exposition being a fixed festival, it would seem appropriate for its promoters to take the initiative in an attempt to realize this very delightful prospect.

Chemists in Public Life

WHEN the President appointed Dr. BOGERT as a member of the Tariff Commission, chemists generally welcomed the action as tangible evidence of the appreciation of the important part which a chemist could play in such an organization. Although Dr. BOGERT found it impossible to accept the appointment, there is no doubt that the profession should be represented on this important board, which bears such a vital relation to chemical industry. It is to be hoped that a chemist will yet be found to take the post.

Another evidence that the chemist is participating in public affairs is noted in the nomination of Dr. E. F. LADD as North Dakota's Republican candidate for the Senate. Dr. LADD is a chemist, having previously been professor of chemistry in the North Dakota Agricultural College, of which he is now president. Without knowing to what extent Dr. LADD may represent the socialistic ideas of the Non-Partisan League of his state, we may nevertheless express the hope that, if elected, he will bring to bear on public affairs a mind trained in that kind of straight thinking which is developed by scientific education. When Dr. LADD'S example is multiplied several fold, we can begin to look for benevolent effects in modifying the views of lawyers and professional politicians.

The I.C.C. Rivals Pandora

WHEN the Interstate Commerce Commission started a series of priorities for coal it opened a box of troubles for this country which makes Pandora's box of fairy fame seem quite insignificant. To be sure, coal is fundamental to all industries and a shortage of coal is perhaps as serious a matter as can readily be imagined for any community, but the cure chosen by the I.C.C. bids fair to establish more problems demanding immediate attention than a dozen such commissions can care for. In fact, it seems likely the disease would be preferred to the cure which has been devised.

Recently it was reported that all Japan was experiencing a financial disturbance approximating panic simply because of the collapse in the silk market. Here it was a dominating industry upsetting all the rest. In this country we seem in a fair way to establish a similar period of hard times by the collapse of transportation facilities resulting from excessive diversion of freight cars into coal traffic.

More serious even than this industrial disturbance is the possibility of direct hazard to whole communities which are just now reporting that they cannot even get the necessary chemicals for water purification. Such a situation, involving contaminated city water, would be even more serious than temporary fuel shortages for our vital public utility concerns.

Not only are important chemical supplies being thus disturbed, but essential road building is altogether interrupted, construction work is at a standstill and we are in a fair way toward hard times for much of our industrial fabric simply because raw materials are not available and the product of our factories cannot be moved from the storeroom. All this, too, is the more regretted when there is certainly some question as to whether there has actually been any general serious coal famine threatening in this country this year.

The total quantity of fuel required in the United States is rather accurately known. We have had shortages in production below the average estimated requirements, and locally throughout the country there have

been deficiencies in supply that threaten interruption of gas, electric and street railway service and industrial activity of less direct public importance. However, the method chosen to correct this difficulty seems to have resulted simply in a topsy-turvy industrial situation.

Unfortunately the tremendous powers of the I.C.C. under the 1920 transportation act have been used simply to give cars for coal movement. There seems to be no machinery available, certainly none actively in motion, for the elimination of unnecessary fuel uses or the increase of efficiency of fuel utilization. Either of these two limitations would doubtless be adequate if means for their accomplishment had been available. It is time for the technical man to give thought to these matters, especially to the question of increasing the work done per pound of fuel supply. It is a problem of greatest national concern and one to tax the ingenuity of our most clever engineers and chemists.

Study of Failures The Road to Perfection

DEFECTIVE metal furnishes a fascinating field for metallurgical investigation—gripping the huntsman instinct in the searcher and rewarding him with information of utmost importance to one really striving for reliability in manufactured products. Human life so often depends upon stanch reliability, yet every now and then a failure occurs in such a most mystifying way that the onlooker is apt to exclaim, "A plague on all your pseudo-science!" Yet why should a new cast-steel bridge seat suddenly fail at a critical moment, precipitating a whole span into the river, although under lower stress than it withstood many times during erection? Who can convince his fellow of the real reason for the epidemic of flakes, as soon as Americans tried to make gun forgings in quantity? Why are transverse fissures in rails, where do they originate, and how can they be avoided? Until such questions as these are answered, metallurgists are far from that ideal which they should hold in common with physicians: "Each ailment must be susceptible of accurate diagnosis." This is evidently prerequisite to the ultimate goal of "preventive medicine."

One naturally likes to talk more about his successes than his failures, even though he is taught far more by one shortcoming than by a hundred victories. The metallurgist will point with pride to the tremendous tonnage which fulfills its expected service in a satisfactory, if not an unexceptional, manner, far rather than dwell upon the faulty material which also slips through. Here is the very trouble! A defective heat, or a defective ingot, or a defective beam, bar, rail or rod may exert its influence so subtly as to be unobserved and only recognized so long after the event that the details of its manufacture cannot be recovered —in fact, it was apparently made under exactly the same conditions as its predecessors and successors, all acceptable.

It is only natural that the steel maker should blame the service to which his metal has been put, and that the user should blame the manufacturing processes. Both periods in the piece's history are so very intricate that usually it has been impossible to locate the exact trouble—at least so far. But this "passing the buck" gets absolutely nowhere. Progress certainly would result should we all adopt Dr. GIOLITTI'S suggestion, made on page 149 of this issue, that each destructive abnormality, or even suggestive observation, should be recorded immediately with all possible collateral evidence, and then given the widest publicity. Successful manufacturing processes are so extraordinarily complex that systematic research designed to synthesize a correct procedure is well-nigh impossible. Evidently greater hope lies in the study of a great mass of data on individual occurrences which are known to affect the quality of the product. CHEMICAL & METALLURGICAL ENGINEERING welcomes such material, believing firmly that along this road lies success in the effort to make good metal better.

A Noteworthy Case of University Industrial Research

IT HAS been but a year since the evaporator experiment station at the University of Michigan was completely equipped, but in that brief space of time investigations of a fundamental character have been made in the phenomena of heat transfer. The actual factors entering into industrial operation are being sought out and intimately studied one by one. The investigators have the advantage of being in the proper environment. They are away from the multitude of interferences such as the plant investigator invariably has to contend with. They can be autocrats, for the evaporating equipment is to serve them and their work only.

In the end they will deduce practical theories on evaporation and evaporator design which at present rest almost wholly on a pure-science basis, without cognizance of many practical factors. The student chemical engineer who undertakes an investigation under these conditions has quite as much incentive for work as his brother chemist in the research laboratory. He will not be frittering his time away on a toy machine with no more satisfaction than a child gets out of his electric train. And when he finishes his work he will hold rank in accordance with his academic accomplishments. If he is endowed with tact and other natural qualities, he can advance rapidly in an organization that has use for his kind of special training.

Full-sized steam plants have been part of the equipment of almost every institution where mechanical engineering is taught. It would be too much to expect every department of chemical engineering to follow this example and erect full-sized equipment in adequate variety to offer as complete facilities as are given in mechanical engineering. On the other hand, might it not be possible for different institutions to emphasize certain operations, and equip their laboratories accordingly?

For post-graduate work, at least, this plan would offer excellent facilities. There is much to be said both for and against full-sized equipment in school laboratories. It is seldom necessary for purposes of instruction only, but where industrial investigations are to be made, it may be impossible to interpret results gained in any other than large-scale apparatus. The Michigan example is an interesting one and should be suggestive to other institutions where chemical engineering is taught and where the lead may be taken in at least one field of industrial research.

Ceramists' Dream Of the Future

IF YOU will wander, some fine day, out into the hills with the geologist, he may point to this and that example of differential weathering on the rocks and say: "It took ten million years for these few inches of rock to wear away, or one hundred million years to erode that gully." All of which, aside from giving you the impression that our historians have been remiss in recording the total period of world existence, will prove that natural silicates stand the weather pretty well. Then if you sit right down on the hillside and think about it out there in the clear sunshine, there may come a real dream of the greater part that ceramic materials must play in our future structures, and how the eroded dust of these rocks lying in clay beds on the plain below may be re-covered and re-formed to rocks with wearing characteristics equal to the natural product.

The clay worker may exceed the works of nature as regards refractoriness and strength and fabrication to any shape until the day will come that even the metals will be displaced in some of the useful arts, and the ceramist comes into his own at last.

Obstacles to Prosperity

PROSPERITY and progress, when applied to a people, are almost synonymous terms. No difficulty should be experienced in distinguishing from mere activity. Business can be very active without there being real prosperity or actual progress. Men may be working hard all day without being efficient and without producing lasting and useful results. It is easier to have business activity, merely as activity, than to have the kind of activity that makes for prosperity and progress.

These remarks are intended to have a particular bearing on the subject of new construction. A certain amount of construction is needed to make up for natural depreciation, and a certain amount in addition is needed for progress. Of late there has been much more activity than progress or true prosperity. In particular there has been little new construction.

There are four major obstacles, or difficulties, in the way of construction work, those that represent an investment intended to yield annual returns as well as eventual replacement of the principal. There are: (1) High interest rates for capital. (2) Indifferent performance of workmen. (3) Poor rail transportation service. (4) Unreasonable prices.

High interest rates for capital are naturally a deterrent to investment construction, since they offer the investor another form of investment. We are in a little danger just now, by the way, of getting a fallacious idea as to interest rates, for it has been contended seriously in some quarters of late that since both wages and commodity prices have gone up the interest rate ought to go up too. The misleading expression "cost of capital" is used. There is really no comparison, for capital goes by an interest expressed in percentage. One would not argue that, in the case of a factory, a larger percentage of the income should be used to buy raw materials than before the war, a larger percentage should be used to pay wages and a larger percentage should be left for profit, for the total can be only 100 per cent. If capital does command an unusually high percentage rate, that is merely an indication that there is something unsound, and a serious deterrent to construction work is furnished.

As to the performance of workmen, the barrier or obstacle may not be as great as is often supposed. Performance is a relative matter, moreover, and when one considers the making of an investment that involves the employment of labor he must compare present labor efficiency with prospective efficiency, not past efficiency.

The poor rail transportation service now furnished is a great obstacle to construction work, for various materials must be assembled, and if one is lacking, the whole work suffers and the cost of the job is increased.

In calling unreasonable prices the fourth obstacle to construction work the word "unreasonable" is used advisedly. For a few months after the Armistice there was much arguing that we had inflation of various sorts, hence prices would have to be high, but there have been great divergences. It is not reasonable that some prices should be double their pre-war average, others triple, and still others up only 50 per cent. Granting that the average is right, some prices are too high and some are too low. The investor can see these discrepancies and naturally concludes that while everything may not be wrong, some things are wrong, and he is disposed to wait until there is a better balanced price structure.

The Industrial Nurse As an Asset to Industry

NURSES are beginning to appear in industrial establishments, and the reports of them are generally favorable. Where plants are isolated and the workers live in company houses or in proximity to the works, there is the same need for the industrial nurse that there is for a district nurse in any community. Under such circumstances she is a regular visiting nurse whose business is to temper mercy with judgment, yet always to abound in mercy; to be part doctor, part priest, part lawyer, all nurse and then some more. She must be singular in her very multiplicity of qualities. The right woman on the job has a nose for trouble in its brewing, does not tell tales, has the confidence of everyone and knows how and when to give advice to all sorts and conditions of men and women. Her price is above rubies. And the wrong woman on the job can cause more trouble than a brimstone match.

In other establishments, no matter how centrally located, such nurses are engaged to be on call in the works during business hours. Not only where women are employed but also among men she knows just how to handle minor accidents, how to patch and bind up fingers, to look after sanitation, to make a gentle fuss if things get foul anywhere and to give good advice to grown up, strong, burly children. Then, too, in case of a major accident, she knows just what to do until the doctor comes, and also when to send for the doctor, which is an art in itself. She has a keen eye for septic conditions even in little scratches, and under workmen's compensation laws her precautions often save large sums of money as well as fingers and hands and arms or toes and legs and even lives. There is a National Organization for Public Health Nursing, with headquarters in Cleveland, Ohio, that is providing special training for nurses in the industrial field. The work is useful and the women are needed.

Western Chemical & Metallurgical Field

Company Reports

Anaconda Copper Mining Co.

Though the year 1919 was one of uncertainty in the non-ferrous metal industries and one of reduced production, the Anaconda Copper Mining Co. has retained its organization and taken advantage of the curtailment of operations to carry out extensive improvements in the mines at Butte, to continue and largely complete construction under way at the various plants and to advance, without interruption, the South American undertakings. Definite steps have also been taken in enlarging the company's field of activity.

The smoke treatment plant at Anaconda, consisting of twenty Cottrell treater units, was put into commission during the year and has demonstrated its efficiency. A special reverberatory furnace with Cottrell treaters was also completed for smelting the dust from the main treaters and satisfactory recovery of the copper, silver, gold and arsenic is obtained. Construction of an arsenic refining plant of 400 tons monthly capacity was begun and partially completed and when finished will refine the arsenical dust from the treaters on the special reverbatory.

An experimental 25-ton tower acid plant has been constructed and its operation demonstrated this new system of producing sulphuric acid to be an unqualified success. This type plant will be used in connection with the production of acid for the treatment of phosphate rock at Anaconda. The erection of an experimental plant to produce about thirty-five tons of a product containing 48 per cent of soluble phosphoric acid was begun. The product is to be marketed under the name of "Treble Acid Phosphate." To supply the phosphate rock a deposit near Garrison, Mont., was acquired and development work undertaken. The right to purchase a large deposit of high-grade phosphate rock in Caribou County, Idaho, has been acquired. About 25,000,000 tons of rock can be mined from this deposit through tunnels. Plans have been made to install the necessary machinery and townsite facilities to begin active operations.

An additional rotary converter was installed at the Great Falls electrolytic zinc plant substation in order to have a spare unit when operating the plant at full capacity.

A plant for the production of white lead made by an electrolytic process is being erected at East Chicago, Ind., adjacent to the plant of the International Lead Refining Co. This plant will be operated by the Anaconda Lead Products Co.

Considerable development work has been carried on in South America by the Andes Copper Mining Co. More than 12,000 feet of churn drilling has added 33,000,000 tons to the reserves, making a total of 120,000,000 tons of ore having a copper content of 1.48 per cent developed. Work on the main water supply and on the townsite has progressed satisfactorily. The Potrerillos railway was completed in May, 1919. General drawings of the reduction works have been completed and a pilot plant, located at the mines, has been put in operation. In this working unit tests are being conducted and the problems which arise in the application of the process are being worked out.

Consolidated Mining & Smelting Co. of Canada, Ltd.

The plant at Trail is becoming an increasingly important factor in the development of the natural resources as well as in the industrial expansion of western Canada. Various departments have been enlarged, new departments have been added and marked progress has been made in the recoveries of metals and in the concentration of ores during the past year. The present electrolytic copper refinery has a capacity of twenty tons of refined copper per day. This is being increased to fifty tons per day capacity to take care of the production of the Canada Copper Corp. A copper rod mill of the same capacity is being built. Improvements in the efficiency of the electrolytic lead refinery have reduced the cost of producing lead by this method below that of a Parkes process plant operating on the same tonnage. The gold and silver refinery has been practically rebuilt and is now thoroughly up to date. A new method of concentrating the ores from the Sullivan mine has been developed which consists of low-temperature roasting and wet magnetic separation; the concentrator has been recently completed. This will result in decreasing the cost of producing electrolytic zinc by providing a more satisfactory product for the plant. The sulphuric, hydrofluoric and hydrofluorsilicic acid plants are in satisfactory operating condition. A flotation mill of 200 tons daily capacity was run for several months on Rossland ore and its operation proved that this can be concentrated at reasonable cost and with good recoveries. A 1,500-ton mill is planned.

The company is expanding its activities particularly with the idea of increasing the production of copper and with this end in view has acquired controlling interests in the Coast Copper Co. and the Sunlock Mines, both on Vancouver Island.

Production for fifteen months ended Dec. 31, 1919, was: Gold 59,605 and silver 1,782,025 oz.; lead 41,711,-147, copper 6,933,962 and zinc 30,743,461 lb.

Water Power Act Regulations Being Drafted

Regulations to be used in carrying the Water Power Act into effect are being drafted by Oscar C. Merrill, the executive secretary of the Federal Power Commission; General Enoch H. Crowder, representing the War Department, and Herman Stabler, representing the Interior Department.

Applications for permits under the new act now approximate 1,000,000 hp.

Lieutenant Colonel William Kelly of the Engineer Corps has been appointed by the President to serve with the Power Commission as Engineer Officer. Much of Colonel Kelly's experience in the Engineer Corps has been in California, where he has been brought in contact with water power problems. He was in France with the 117th Engineers.

COCONUT GROVE

Philippine Industrial Material, Products and Resources Available to the United States

A Review of the Greatly Diversified Agricultural, Mineral and Other Resources in the Philippine Islands, and the Opportunities to Increase Their Supply — Manufacturing Possibilities and Advantages of Locally Developed Industries

BY DR. ALVIN J. COX*

THE people of the United States have been so busy with their own affairs and the development of their own natural resources that they have given too little time to the study of their neighbors and trade possibilities on the Pacific. San Francisco, which could best handle and make use of the raw materials from Pacific Coast tributary countries for manufacturing development, especially on account of her location and climate in which work can be carried on uninterruptedly throughout the year, has been insufficiently active; and California generally has been so interested in agriculture that it has given much too little thought to industrial achievement.

Information concerning Philippine commercial and industrial possibilities has been given out periodically in the United States, but at no time has received the attention it warranted. The Philippines is not a foreign country, but is under the flag of the United States, and, while not an integral part of the United States, her judicial tribunal is maintained under American auspices, a condition which greatly facilitates business transactions with this country. The Philippine Government is doing everything possible to improve its harbor and docking facilities by the construction of additional piers, coal and oil depots, etc., to accomodate shipping. The mercantile and financial interests of the United States, including manufacturing, agriculture, shipbuilding, the export and import business, oil, mining and timber industries, transportation and public service interests, etc., should awake to Philippine possibilities.

The development of the Philippines will be an important asset to the section of the country accomplishing it and large profit will accrue not only to the business concerns directly interested but also the business community generally in attracting, centralizing, facilitating and increasing industrial and economic trade development. In my opinion the United States should bid especially for the foreign raw materials and business of the nations and their dependencies of the Pacific, and particularly for those products of the Philippine Islands suitable for export.

Many products now made from imported Philippine raw materials could be produced more cheaply there and the finished product imported, thus relieving our labor shortage. Exporters must join the importers in any development drive, for it should be realized that money spent there goes into a country where it is to our advantage to increase the purchasing power of each resident, for that increase largely will be spent for the purchase of American manufactured materials, if we adapt our methods to the needs and desires of the customers. Furthermore, by buying raw materials in the Philippine Islands, we are building up a line of supply that will not be interrupted by European wars. Why not build up a dependable supply not subject to those interrupting conditions?

AGRICULTURAL PRODUCTS

The Philippine Islands at no time have produced sufficient rice for local consumption, preferring, or finding it more profitable, to bring forth their well-known agricultural export products, such as abacá (Manila hemp), tobacco, coconuts and sugar cane, which always afford an excellent investment. With the shortage of binder materials during the last few years the producer of abacá has reaped a particularly valuable harvest. Even in ordinary times the supply of abacá

*Director, Philippine Bureau of Science, 1912-19.

is insufficient and the plant is peculiar in that it cannot be grown elswhere than in the Philippine Islands. It is believed that there will be a shortage for many years to come; for that reason the U. S. Bureau of Agriculture is endeavoring, by a special representative, to stimulate the production of sisal and maguey as a secondary Philippine supply. Many of the tobacco lands of the world have been turned to the production of essential food crops. Although tobacco was profitable before the war, the prices are now much higher, and probably will continue so for several years. The dried meat of the coconut is marketed for the production of oil. Coconut oil yields more glycerine than any other similar substance and has found an excellent market during the war period. However, coconuts will prove to be an exceptionally valuable crop at any time, for there is less likelihood of finding a chemical substitute for coconut oil than for any other Philippine product.

The exports of sugar from the Philippines in 1918 exceeded those in 1917 by more than 147,400,000 lb. During the last year there has been a great stimulus in the construction of sugar centrals, but even yet the production by native methods of the much less profitable raw sugar greatly exceeds that of centrifugal sugar. Many regions in the Philippines are ideally suited to the growing of sugar cane and on account of the great profit the production of sugar by modern methods will continually increase. Abacá, tobacco, coconuts and sugar cane largely have export markets. In 1918, there were exported 374,000,000 lb. of abacá, 360,000,000 cigars and 57,200,000 lb. tobacco in other forms. Also there were exported 121,000,000 lb. of copra (dried coconut meat), 253,000,000 lb. of coconut oil, 140,800,000 lb. of centrifugal sugar and 462,000,000 lb. of raw sugar. These had a value of about $59,000,000, $7,000,000, $6,000,000, $5,000,000, $31,500,000, $6,000,000 and $10,000,000 respectively.

Although there has been an unusually large increase in the exports of abacá, tobacco, coconuts and sugar cane since American occupation of the Philippines, still there is under-production and the cultivation of each can with profit be greatly increased. There is every evidence that the selling price of these products will continue at a fairly high level for years to come, particularly in view of the increased uses and the utilization of what formerly was waste product. For many months the copra market has been steady with a price more than three times that at which it formerly was profitably produced.

Besides the multiplication of these well-established products there is a wealth of natural and industrial possibilities that it is the purpose briefly to discuss here.

Philippine Alcohol and Beverages

There is a shortage of alcohol for industrial purposes, partly due to diminished production. The curtailment of consumption by the enactment of prohibition laws has not equalled the increased industrial demand. There are three of the cheapest sources of alcohol in the Philippines—namely, discard molasses from sugar-cane mills, tuba (sap) from the flower stem of the nipa palm and possibly from the coconut palm, and starch from the starch plants. Almost the entire insular production, about 10,000,000 proof gallons per annum, is made from the tube of the nipa palm. This palm grows wild in tidewater swamps. There are large areas of nipa-palm swamps that have not been developed. The collection of discard molasses is now difficult, owing to the production of sugar in many small mills; but when central mills ar. in general use, about 7,000,000 gal., capable of producing 5,000,000 proof gallons of alcohol, will be available annually. The growing of starch plants for the production of alcohol is very encouraging. Both cassava and arrowroot give much better yields and are just as easy to handle as ordinary potatoes, which have been found to be a cheap source of alcohol in continental Europe. With development, the Philippines practically could obtain a monopoly of the alcohol industry.

Most of the alcohol at present produced in the Philippine Islands is used locally for fermented drinks. Distilled spirits from the fermented sap of nipa and coconut palms, stored for five years in casks, are named "Philippine coco palm brandy" and "Philippine nipa palm brandy." Analyses made by the Bureau of Science show that these products conform to the requirements of good brandy.

Palm Sugar

Excellent sugar has been made from the sap of several palms, but the product is absorbed by the local markets. The buri palm is too scattered to be a great commercial source, but the nipa palm, which grows in immense areas on tide land in various parts of the Philippine Islands and yields a sap which is now the source of alcohol, is available. Nipa sap has a composition similar to that of the juice of sugar cane and it can be used more profitably for the production of sugar than for alcohol. There are large areas of nipa swamp that have never been developed. The fronds are used for thatch.

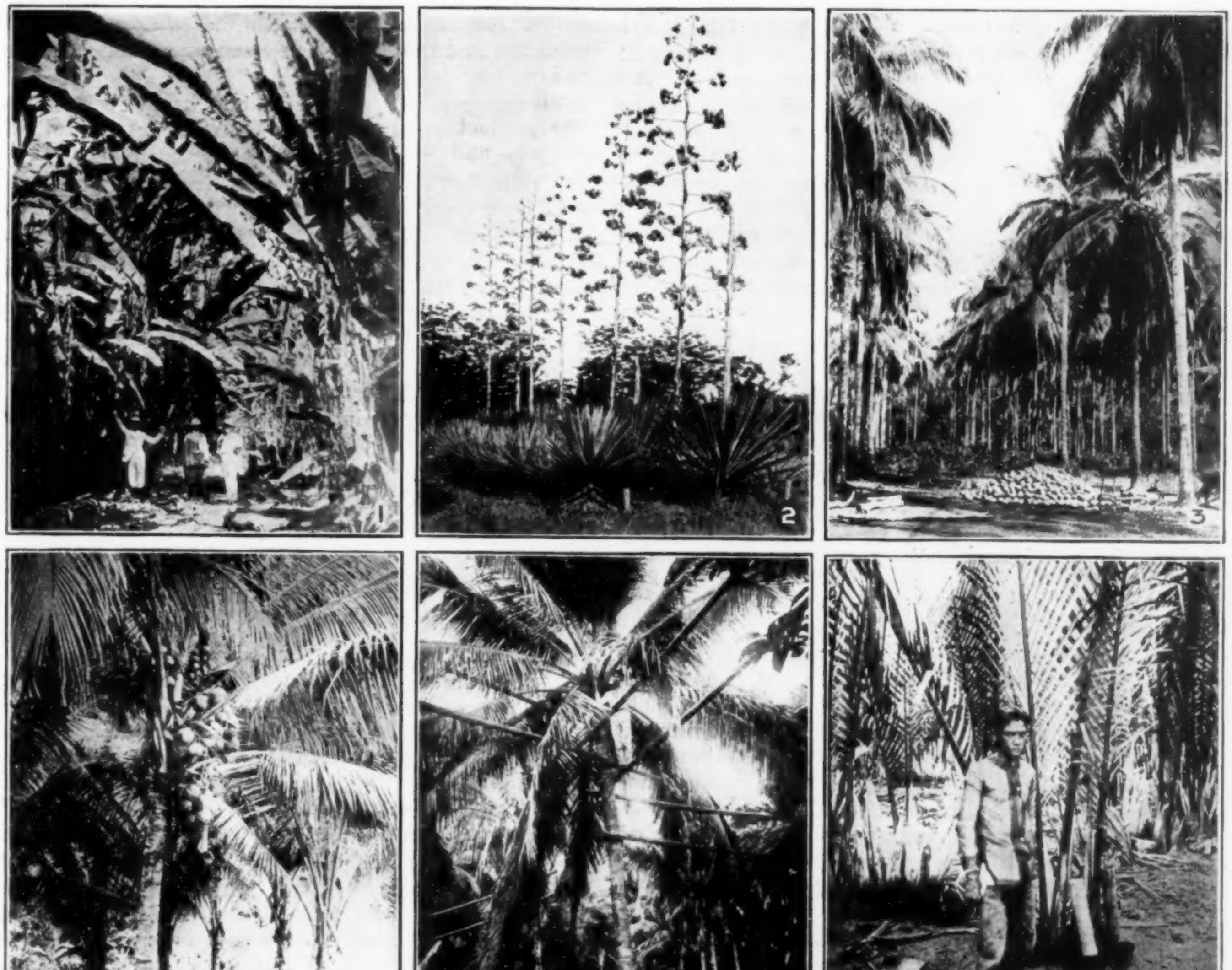
Coconut Shells and Charcoal

Coconut shells were not exported in large quantities before the declaration of war, although scientists long have used them for producing high gas-absorption-power charcoal. In 1918 more than $500,000 worth of coconut shells and $125,000 worth of coconut-shell charcoal were exported. It is hoped that this industry so nicely started may be maintained. Charcoal also has been made from mangcono wood and lumbang and pili shells, with a view to determining the efficiency of charcoals made from materials available in commercial quantities in the Philippine Islands. Results indicate that pili-nut-shell charcoal has a higher gas-absorption power than any other charcoal made.

Philippine Fibers and Binder Materials

Abacá, besides being exported as such, is used in the rapidly growing Philippine cordage industry. Frequently maguey and other fibers are cheaper than abacá, and they are as satisfactory for many cordage purposes. In 1918 the cordage exports amounted to more than $1,100,000.

The fiber extracted from the petioles of the buri palm is used for making buntal hats, which are marketed in the United States as Bangkok hats. The buntal hat is one of the best hats of the Philippine Islands. Fine hats made from bamboo fibers are marketed under the name of Batavia hats. Several fibers are used in the manufacture of high-grade hats similar to Panama hats. Hats made from buri palm leaves are cheaper and better than the cheaper hats sold in the United States. Abacá affords an abundant supply of excellent raw material which is woven into women's hats.



FIGS. 1 TO 9

Fig. 1. Abacá plantation, Malita, Davao. Fig. 2. Maguey in fruit, La Carlota, Occidental Negros. Fig. 3. Coconut grove and pile of nuts. Fig. 4. Coconut tree in fruit. Fig. 5. Bamboo bridges connecting tuba coconut trees. Fig. 6. Nipa palms. Fig. 7. Carica papaya trees in fruit. Fig. 8. Para rubber plantation trees, Basilan. Fig. 9. A tapped Castilloa elastica tree.

The commercial rattans of the Philippine Islands are derived from the climbing palms. The many species in the Philippine Islands belong to three genera. The stripped material of some species is very tough; it has great tensile strength, does not break easily in bending, and can readily be bleached. There is no reason why a considerable export trade in Philippine rattans should not be developed.

There are various species of trees and certain small shrubs represented in the Philippine Islands that have between the wood and the bark a tough fibrous layer known as bast fibers. These have extensive local use as substitutes for abacá.

Coconut husks yield a valuable fiber known as coir. In the Philippines a new and profitable industry can be established by using coir for the manufacture of brushes, ropes, doormats, etc. In the coir industry all the processes employed are simple, and machinery need not necessarily be used. In beating out the fibers two classes result—the coarse brittle fiber averaging 12 in. in length and the finer mattress fiber. The latter may be spun into coir yarn. One thousand coconuts will produce from 66 to 77 lb. of brittle fiber and about 308 lb. of mattress fiber.

True cotton is cultivated and made into various articles for local use. Pineapple fiber and some of the above-enumerated fibers are manufactured into cloth for which there is a certain export demand. Cloth known as piña, made from the pineapple fiber, is similar to very fine linen, and is used especially in making fine embroidery. Sinamay, made from abacá, is similar to crinoline and is used for similar purposes. The so-called Ilocano cloth, made from cotton, has a characteristic weave and coloring and is popular for curtains, pillow covers, etc.

Tree cotton, kapok, while of too short a fiber to be of use as textile material, is a superior filling for pillows and mattresses. The fibers are oily and, therefore, do not become easily water soaked. For this reason kapok is a suitable filler for life preservers, life jackets, etc.

Resins, Terpenes, Perfumes, Edible Nuts and Vegetable Oils Other Than Coconut Oil

Elemi, balao, apitong, almaciga and copal find application in the varnish industry, and in the making of resin soaps. The essential oils of ylang-ylang, champaca, vetiver, lemon grass, orange, cinnamon and ginger are used in the perfume industry, and several of them are used in the manufacture of non-alcoholic beverages and fruit flavors.

The pili nut is very delicious and has a flavor similar to that of the Brazil nut. It is very rich in oil.

Important vegetable oils are produced in the Philippine Islands from the physic nut, peanut and pili nut, and from the seeds of lumbang, kapok, cato, cashew, castor bean and cotton. Lumbang oil has good drying qualities and is used in the varnish and linoleum trades. The Indian variety of castor bean grown in the Philippines gives a high oil content. Cultivation is simple and does not involve so much actual work as does the growing of other staple crops, and returns are certain.

Commercial Plant Products

Coffee grows well in several parts of the Philippine Islands, and beans of excellent quality are produced, especially in the highlands of Luzon. Scientific cultivation is probably necessary to increase the output.

First-class cacao is grown to limited extent in many localities, and the production could be readily increased to export proportions.

Papaya gum of as great activity as the best on the market has been and can be produced in the Philippines, and offers an industry new to the islands.

Strychnine can be extracted from the seeds of *Strychnos ignatii*, a plant indigenous to the Philippines.

The leaves and the seeds of *Datura alba*, which grows wild in the Philippines, are valuable as an asthma remedy and for other medicinal purposes.

Several species of Philippine plants yield a high percentage of starch. The most promising of these are cassava, or camoting cahoy (*Manihot utilissima pohl*), and tapioca. Among other possible sources of starch are arrowroot (*Maranta arundinacea linn.*), sincamas (*Pachyrhizus erosus urban*), the Polynesian arrowroot (*Tacca pinnatifida forst.*), yams (*Dioscorea*), the seeds of *Cycas circinalis linn.* and the sugar palm (*Arenga saccharifera labill.*).

Natural vegetable dyes are used locally. More than $400,000 worth of sapan wood was exported in 1918.

Rubber and Gutta-Percha

The indigenous Philippine rubber-producing plants are vines and are scarcely adapted to cultivation. The cultivated rubber trees, the plants that produce so-called para, ceara and castilloa rubbers are, without exception, native of tropical America. All of these species have been introduced into the Philippines and do exceedingly well. In 1917 I was shown 7-yr.-old para trees on a plantation near Isabela de Basilan that were said to yield 2.25 kg. of rubber per tree per year. The *Castilloa elastica*, a tree native of Mexico, seems adapated to the Philippine Islands because it is not attacked by wild hogs. There have been some remarkable rubber yields from 4-yr.-old trees of this species. Castilloa is given no cultivation and is frequently planted in a new clearing. The cultivation of rubber trees on a large scale will probably prove eminently successful in those parts of the Philippines outside of the typhoon belt, where there is a uniformly distributed rainfall—that is, in southern Mindanao and the Sulu Archipelago.

Lumber, Tanbark and Leather

An entire bureau of the Philippine Government is devoted to forestry and is in charge of forest administration. The virgin forests of the Philippines cover more than 40,000 square miles, and in addition there are about 20,000 square miles of second growth forests. The principal virgin forests are dominated by trees of the *Dipterocarp* family, and the stand of these may be estimated roughly at 18,000 board feet per acre, although several times this amount is not unusual. Practically all the timber belongs to, and is administered by, the government. At present there are about thirty-seven sawmills operating in the Philippine Islands, of which six cut over 25,000 board feet per day and five from 12,000 to 20,000 board feet per day. The total cut of the mills of the Philippine Islands in 1918 was about 70,000,000 board feet. There are large quantities of timber in the Philippines suitable for interior finish, furniture, cabinet wood, heavy construction and for special uses. A supply of timber for almost any purpose is readily available.

The area of the mangrove swamps of the Philippine Islands is estimated to be 511,500 acres. The bark

FIGS. 10 TO 17

Fig. 10. Rudimentary method of stripping abacá. Fig. 11. Drying abacá. Fig. 12. Opening coconuts for sun drying. Fig. 13. **Native copra (dried coconut meat) press. Fig. 14.** Modern coconut oil plant. Fig. 15. Native sugar-cane mill in operation. **Fig. 16. Filipino women making buntal hats. Fig. 17.** Filipino preparing rattan for use in making chairs.

from the mangrove yields an excellent tanning material. Cutch, the evaporated water-extract of tanbark, is imported into the United States in large quantities. This is extensively used in tanning leather, and is supposed to be the basis of khaki dye. The value of tanning materials imported into the United States is nearly $2,000,000 per annum and tanners are becoming each year more dependent upon imported material. Bark from the better species of Philippine mangrove trees contains 30 per cent of tannin. A net profit of from $25 to $30 per ton can probably be made on tanning material derived from the mangrove swamps in the Philippine Islands. Piles, firewood and the products of wood distillation could be made in connection with the cutch industry. The bark of Benguet pine and of palo maria can be also utilized as tanning materials. Forest regulations prevent the cutting of palo maria exclusively for its bark. The scope and possibilities of the tanning industry in the Philippine Islands may be inferred from the fact that about $2,500,000 worth of leather is used annually. More than half of this demand is met by importation. In 1918 more than $2,000,000 worth of leather and manufactures thereof were imported into the Philippine Islands. Some high-grade leather is produced locally, and there is no reason why the entire supply should not be produced in the islands.

Paper Pulp

One of the bamboos, known as cana bojo, has been shown to be especially suitable for the making of paper pulp; it grows in sufficiently large and pure stands to make possible the commercial production of paper pulp. Abacá waste, cogan, talahib, rice straw, etc., are other materials from which the Bureau of Science has made strong paper pulp and which it should be possible to utilize commercially for the same purpose. There is a Philippine law authorizing a bonus for the establishment of a paper-pulp factory in the Philippine Islands.

Insect Products

Wild bees are plentiful in all of the wooded portions of the Philippines. There is a considerable local trade in excellent honey and wax, which are collected by the crudest methods. Apiculture with domesticated bees should be developed. It could be carried on in connection with farming to the extent of excluding imported honey, and the pollenation of all plants would be improved.

The Bureau of Science has introduced silkworms into the Philippine Islands, and has developed a hybrid which has nine generations yearly. The worms do well in the Philippines. Their food, the mulberry, grows most luxuriantly in all part of the islands and is free from pests. An acre or 440 trees will feed about 3,000,000 silkworms per annum, and the leaves may be harvested two years after the cuttings have been planted. There is an excellent market for all the silk that can be produced.

Sea Products

Among the marine products that have commercial possibilities are trepang (beche de mer), tortoise shell, top-shell (trochus) and other button shells, pearl and pearl shells, window shells, sponges, shark fins, edible seaweed, isinglass, crocodile skins, sardines and other sea fishes, etc.

The trepang industry could be spread readily to various northern islands, although now the catch is confined almost wholly to the Sulu Islands. About $500,000 worth of turban and top-shells were marketed during 1918 and certain of the Manila button factories were forced to close due to the scarcity of shells. It is believed that there are many untouched beds of these shells that might easily be exploited. The pearling industry is well established in the southern part of the Philippine Archipelago. Window shells are used locally in the place of window glass. They can be made into attractive screens and lampshades. The collection of sponges in Philippine waters is comparatively a new industry. The elephant's ear sponge collected in the territorial waters is of great value. The export of shark fins amounted to $60,000 in 1918, and this could be greatly increased. Practically all the marine products could be greatly increased.

Sardines are found in Manila Bay and in certain other localities in the Philippine Islands in abundant quantities, sufficient to warrant the establishment of canneries. In addition to the true sardines, there are large numbers of small clupeoid fishes (small herring) which are allowed to be labeled "Sardines." There are found in the Philippines the tuna and a number of other fishes, such as the Spanish mackerel or king fish, Japanese mackerel and several species of the pampano family, that are well adapted to canning purposes. Coconut oil, which is manufactured in the Philippine Islands, could be used for a local sardine product, for the temperature everywhere is above the solidification point of the oil. Olive oil and soya-bean oil for this purpose should cost about the same as in the United States. There are large quantities of peanuts grown in the Philippine Islands, and some of the oil companies plan to manufacture the oil, so this too might be available for canning purposes. The Filipinos prefer their sardines in tomato sauce. Tomatoes grow well in the islands, and this would be the cheapest material to use. Salt is produced locally in quantity from sea water. With this opportunity and these advantages for the establishment of a cannery in the Philippine Islands, $2,500,000 worth of fish and fish products were imported in 1918 simply because no one had taken the initial action in starting this new industry.

Minerals, Metallic and Non-Metallic

The production of gold steadily increased from 1910 to 1916, when a value of $1,408,320 was marketed. The output in 1917 was $1,059,500. Silver is found alloyed with gold in practically all of the gold deposits, in the ratio of one part silver to four parts gold. Silver is found associated with galena in Bulacan, Paracale, Mindanao and Marinduque. There are said to be extensive deposits of comparatively pure galena on the latter island. Copper deposits are known to exist in Batangas, Pangasinan and Benquet Provinces, Mountain Province, Mindoro, Masbate, Panay and Mindanao. Some of these have been worked for years. There are several valuable deposits of iron ore in the Philippines and some of them are exceedingly well located for economic handling of the ore. An unworked laterite iron-ore deposit in Surigao, Mindanao, has been estimated to contain over 500,000,000 tons of available ore, averaging approximately 50 per cent iron. Manganese occurs as psilomelan, pyrolusite and wad in Ilocos Norte, Panga-sinan, Bulacan, Tarlac and Masbate. Several thousand tons of manganese have been shipped in the last few years.

Petroleum is known to occur in Luzon, Cebu, Iloilo, Capiz and Leyte Provinces, and in Mindanao Island.

The beds of Bondoc Peninsula, Tayabas Province, Luzon, have been especially studied, and are believed to be worthy of exploration by drilling. The oil has a paraffine base and is practically free from sulphur. Commercial quantites of asphaltic materials and bituminous limestone exist in Leyte.

Coal to the value of $2,330,000 was imported into the Philippine Islands in 1918. Almost every island in the Philippine Archipelago and the majority of the provinces are known to contain coal or lignite, and some of these deposits are now being developed and mined.

Desirable raw materials for the manufacture of portland cement occur in the Philippine Islands. Some of these are adjacent to undeveloped coal fields, the fuel from which is suitable for burning cement. Excellent coralline and crystalline limestones suitable for the manufacture of lime occur throughout the archipelago. Asbestiform minerals are widespread in the Philippines. Bat guano occurs in caves in nearly every province. Salt to the value of $250,000 is each year manufactured in the Philippine Islands by evaporating sea water by solar heat. The Philippines also contain mineral resources of fireclay, abrasives, sulphur, stone and artesian and mineral waters, etc.

The principal manufactured products of the Philippine Islands are coconut and other oils, soap, tobacco products, cordage, hats, fertilizer ingredients, buttons, tanned products, embroideries, woven articles, matches, etc. The Rizal Cement Co. has a small modern plant at Binangonan. However, the imports of cement in 1918 were $498,500.

The lime heretofore produced in the Philippine Islands is of inferior quality, and much of that used for sugar manufacture and for other chemical purposes has been imported. The increased production of sugar by modern methods has so augmented the demand for lime that there is now a need for the outpnt of large kilns. The price would be sufficient to insure a handsome profit for good lime. Hydrated lime should find extensive use for road-building and for waterproofing concrete. In the sixteenth annual report of the Director of the Bureau of Science for the year ended Dec. 31, 1917, I pointed out that in lime, sand-lime brick, salt, caustic soda, bleaching powder and chloroform there is a group of allied industries that should be successfully operated together in the Philippine Islands. The success of a caustic-soda plant depends rather on the development of local consumption than on its produc-

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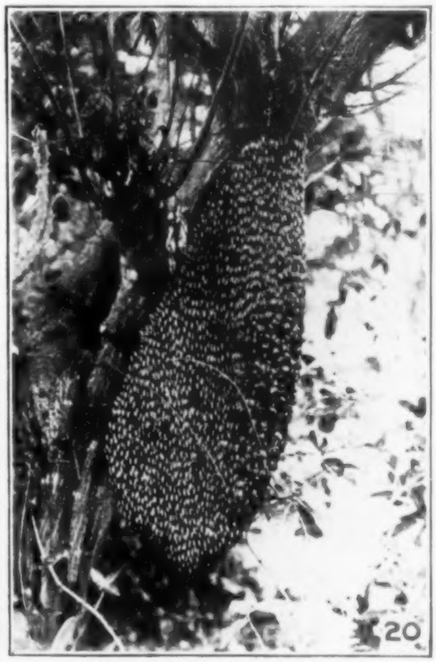

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FIGS. 18 TO 22

Fig. 18. Native abacá press, Albay Province. Fig. 19. Hauling sugar cane (bull carabao). Fig. 20. Wild bees in Cementerio del Norte, Manila. Fig. 21. Cano boho, especially suitable for making paper pulp. Fig. 22. Calumbugan sawmill, Mindanao.

tion for export; and, in addition to utilizing it in the manufacture of soap, thus increasing the consumption, a paper factory and glass industry should be developed. Each of the latter presents an excellent opportunity. The experiments in the Bureau of Science in glass making prove that bottles, demijohns, glass jars, drinking glasses, lamp chimneys, etc., of good quality can be manufactured of Philippine raw material, and the results obtained in the manufacture of paper from Philippine raw materials are also very encouraging.

Clay products and various byproducts from the ash of tobacco wastes, copra cake and other plant wastes present excellent opportunities. Byproducts which up to the present time are largely being wasted but which, if properly developed, may become a source of income to the islands are glycerine, molasses, bromine, iodine, tannin, bleaching powder, chloroform, acetic acid and its derivates, wood alcohol and several other products derived from the dry distillation of wood, etc.

The Philippine industrial materials available to the United States are far greater than is generally understood to be the case. A few of these are now imported, but there are opportunities to increase the supply of these and develop others. The undeveloped ones and a large supply of all may be produced by engaging in attractive production enterprises in the Philippine Islands in addition to the utilization or importation of the raw materials. In all of the agricultural industries there are excellent commercial opportunities and there is a large amount of virgin fertile soil that could be cultivated.

Alizarine Dyes in South India

The following article regarding the supply and distribution of dyes in South India recently appeared in a Madras paper:

"It is well known that alizarine dyes were, prior to the war, imported mainly from Germany. In fact, out of 6,469,739 lb. of alizarine dyes imported into British India during 1913-14, as much as 4,637,450 lb. —or 71.7 per cent of the total imports—came direct from Germany, and 804,143 lb. (probably of German origin) from Belgium. Imports from Germany during 1914-15 fell to about half the quantity of the previous year, dwindled to an insignificant quantity in 1915-16, and afterward stopped completely.

"On the outbreak of the war strenuous attempts were made by the British Alizarin Co. to increase its output, but not until the early part of 1918 was the company able to send to India any material quantity of dyestuffs. About April, 1918, advice was received from the British Alizarin Co. that it was shipping to its agents in Madras (Best & Co.) five tons of alizarine and that there was good prospect of regular supplies being received in future. The Board of Trade, however, required Best & Co. to certify in respect of each sale that the dye had been sold to a consumer and not to a dealer.

Government Co-operation Granted

"To enable them to do this and to keep down the prices to a proper level, Best & Co. applied to the government for assistance and co-operation. In May, 1918, the government sanctioned the introduction of a scheme by which collectors of districts were asked to constitute local committees to deal with applications for dyes from bona fide dyers. The committees were to consist of two well-known dyers of the locality, with a government official of standing as president of the committee. The applicant for dyes had to make a formal application, and if it was proved that he was a bona fide dyer he would receive a limited supply at a price fixed by the collector of the district. In the case of Madura alone, which is the chief dyeing center of Madras Presidency, an exception had to be made. The system of certificates was tried there for some time, but had to be given up owing to certain circumstances special to that place. Since October, 1919, the distribution of dyes at Madura has been left in the hands of Best & Co.

German Reparation Dyes—Government Control of Prices

"According to the terms of the peace treaty, Germany is to deliver to the Allies a certain quantity of dyestuffs as part of the reparation for the injuries done to the Allied nations. Out of the German dyestuffs allotted to the British Empire, arrangements have been made to secure the whole of the reparation alizarine dyes for India in addition to a portion of the other reparation dyes. These supplies will be in addition to supplies which would, in any case, have been sent to India by the British Alizarin Co.

"The first consignment of German reparation alizarine dyes for Madras has now been received; it amounts to 200 casks of 4 cwt. each. This consignment and future consignments of alizarine dyes expected from this source will also be distributed in accordance with the scheme referred to above. The stock that has arrived has been allocated to the various agencies of Best & Co. The British Alizarin Co.'s new works at Manchester are expected to be completed by June next, and shortly afterward it expects to be able to supply the total Indian requirements from these factories. Meantime the arrangements detailed above will continue to be in force.

"In conclusion, it may be of interest to the public to know that Best & Co., the Madras agents of the British Alizarin Co., are not at liberty to charge any price they choose. The government fixes the price per pound and Best & Co. have to sell the dyes at that rate; they are allowed a fixed percentage as commission on the net proceeds after deducting duty and handling charges. The sale price of alizarine has now been fixed at 1 rupee 3 annas [38c.] per pound at any of Best & Co.'s depots.

Production of Indigo in Manchuria

The annual production of indigo in Manchuria approximates 4,000,000 to 5,000,000 lb., of which about one-third is disposed of in the Mukden market, reports Consul General Albert W. Pontious. The best quality sold there in May at 26c. per 1⅓ lb., and the cheaper grades at 15c. and 21c. In favorable soil the yield per fifteen acres is estimated at from 20,000 to 25,000 lb. of leaves, from which about 533 lb. of crude indigo is obtainable. Previous to the war foreign artificial indigo was imported into the Mukden consular district to the extent of approximately $700,000, and into the whole of China to the extent of $5,500,000 annually. The increasing price of artificial indigo subsequent to the elimination of Germany as a source of supply has made the vegetable indigo industry very profitable again. While a small amount of the foreign indigo is still on sale, the price of $170 per cask of about 175 lb. is practically prohibitive.

The Chemistry of the Brain

By Clarence Jay West*

"THE brain and nervous system control, either directly by nerve impulses or indirectly through the blood stream, the metabolism and activity of all the other tissues of the body. They are, therefore, the master tissue of the body." While the nervous tissue comprises a relatively small part of the entire body, its superior reactivity or irritability enables it to control or set the pace for the other tissues.

The chemistry and metabolism of the nervous tissue are from almost every point of view the most absorbing and interesting of the problems of physiological chemistry. Matthew in his textbook states that the whole of evolution is characterized by the steady development of the nervous system, and by the steady development of no other tissue. The power of adapting the organism to a changing environment has been solved by the development of a tissue of the body which should be most irritable, which should control the other tissues, and which, having memory, could profit by experience. It is by means of his nervous system, and in that respect alone, that man stands at the summit of the animal world.

In spite of the importance and fascination which this study should possess, we know comparatively little regarding the chemical composition of the brain and the properties of the substances which are characteristic of nervous tissue. Much of our present knowledge is due to Thudichum, who worked comparatively unknown and entirely unappreciated, owing to his unusually combative nature, for many years (about 1865 to 1875) in England. The results of his investigations were published in the form of reports during this period, and later were collected in the form of a book under the title "The Chemical Composition of the Brain of Man and Animals." Among the later investigators in this field we may mention Koch, Fränkel, Rosenheim, MacLean, Thierfelder and Levene.

Our methods for analyzing the proximate constituents of the brain are far from satisfactory at the present time because of the complexity of the material in question. The following figures represent in a rough way the composition of the gray and the white matter:

	Gray	White
Water	85.3	70.2
Protein	7.6	8.6
Lipoids	3.1	18.1
Water soluble	0.5	1.4

The composition of the solids of the human brain is given by Koch as follows, the figures being per cent of dry matter:

	Whole Brain (Child)	Whole Brain (Adult)	Corpus Callosum
Protein	46.6	37.1	27.1
Extractives	12.0	6.7	3.9
Ash	8.3	4.2	2.4
Phosphatide	24.2	27.3	31.0
Cerebrosides	6.9	13.6	18.0
Lipoid sulphur	0.1	0.3	0.5
Cholesterol	1.8	10.9	17.1

The protein material of the brain is of the same general composition and nature as that found in the other parts of the body. If there is anything characteristic about it, it is the presence of normal amino-caproic acid. This is a matter probably of not very great significance, and it is unlikely that this acid is found only in brain protein.

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The characteristic property of nerve tissue which differentiates it from all other tissues of the body is the presence of a large amount of ether and alcohol soluble material, which has been called by the collective name lipoids. The scope of this term varies with various investigators, but in general it has been used to include cholesterol, the nitrogen-containing bodies and the nitrogen and phosphorus-containing bodies. It is probable that there also exists a sulphur-containing body in the brain, but whether it contains in addition only nitrogen or whether it contains both nitrogen and phosphorus has not been determined.

Classification of Known Brain Substances

The following classification represents our present knowledge of the substances which have been definitely established. The literature of lipoids is very confusing, because names have been given to bodies which are mixtures of two or more of these, or which contain other impurities.

I. Cholesterol. Really this should not be classed as a lipoid, and is included only because it occurs in the alcoholic extract of nervous tissue.

II. Cerebrins. (Nitrogen-containing).
- *a.* Phrenosin.
- *b.* Cerasin.

III. Phosphatides. (Nitrogen- and phosphorus-containing).
1. Ratio of N : P = 1 : 1.
   - *a.* Lecithin.
   - *b.* Cephalin.
2. Ratio of N : P = 2 : 1.
   Sphingomyelin.

IV. Sulphur-containing compound.

Let us first consider the lipoid materials by studying their methods of isolation. The fresh brain matter is carefully freed from the covering tissue, washed, ground in an ordinary meat grinder, and dried *in vacuo*. This drying is usually carried out at 95 to 100 deg. C. The dried material is then ground to a fine powder and thoroughly extracted with hot alcohol. This removes all of the lipoid material, although as the process of purification continues a large part of it becomes insoluble in alcohol. Upon cooling the alcoholic extract, a large amount of the cholesterol and a certain amount of the nitrogen and nitrogen- and phosphorus-containing bodies separate out.

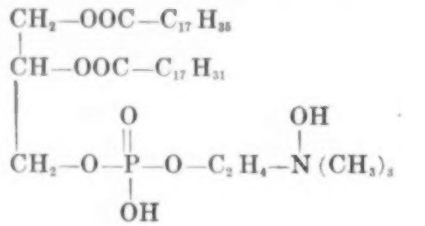
The filtrate will contain the greater part of the lecithin and cephalin. This is evaporated to dryness or to a thick sirup in vacuum and poured into acetone. This procedure precipitates all of the lipoid material and is a means of separating this from the fats and cholesterol. Because of the solubility of the lipoids in one another, this lecithin mixture will contain a considerable amount of the cerebrins and some sphingomyelin. The latter are insoluble in ether, and, therefore, extraction with ether will remove the lecithin and cephalin. Cephalin is insoluble in alcohol, and by dissolving the lecithin-cephalin mixture in ether and pouring this solution into alcohol, we are able to effect a certain separation of lecithin and cephalin. The procedure is very tedious, but finally results in the preparation of a cephalin which is free from lecithin. The preparation of a pure lecithin involves a considerable amount of additional work.

The mixture of cerebrins and sphingomyelins may be separated by a complicated system of precipitation

and fractionation, involving the use of acetic acid, petroleum ether, alcohol, and pyridine. The details of this method have been worked out by Levene and will not be given here.

The sulphur-containing body is found in the same fraction as the cerebrins, and all attempts to obtain a product which is rich in sulphur or which is constant in composition have been unsuccessful.

We thus see that, in general, the lipoid material may be separated into two groups, the solid, almost crystalline (cerebrins and sphingomyelins) and the sticky amorphous lecithin and cephalin. Without going too deeply into the organic chemistry of these bodies, let us look briefly into their chemical composition. Lecithin, which is probably the best known of all of these bodies, is a glyceride which contains one molecule of stearic acid, one molecule of an unsaturated acid, which probably belongs to the oleic acid series, while the third hydroxyl of the glycerol is esterified by means of phosphoric acid, which in turn carries a choline residue. That is, the lecithin molecule may be represented by the following formula:



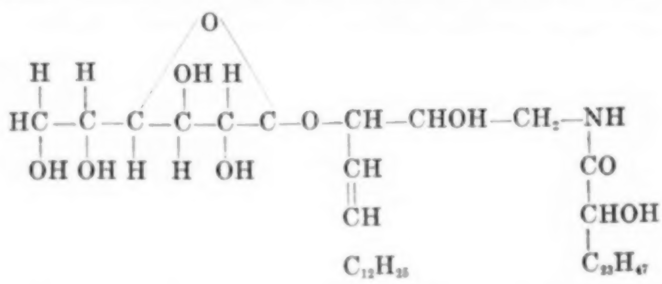
Our knowledge of the chemistry of lecithin was greatly increased by the application of the principle of reduction with hydrogen and palladium, because by this reaction one is able to obtain a crystalline body. Upon hydrolysis of this crystalline lecithin we obtain only stearic acid. This, therefore, does away with the possibility which many investigators have thought probable, that lecithin was a mixture of a stearic acid and a palmitic acid glyceride.

The chemistry of cephalin is much more complicated. Thudichum, who first isolated this body, observed that the carbon content was approximately 60 per cent. The products of hydrolysis were found to be glycerol, stearic acid, an unsaturated acid probably of the linoleic series, phosphoric acid and amino-ethyl alcohol, $NH_2CH_2CH_2OH$. If the composition is calculated from these components, it is found that the carbon should be 66 per cent. Thudicum noticed this discrepancy between the observed and calculated values for carbon, but made no attempt to account for it. Later investigators likewise obtained a cephalin with 60 per cent of carbon, but no attempt was made to explain this difference until Levene started his work. Levene and West spent a year in attempting to so purify cephalin that the carbon content would be raised to 66 per cent, but without success. The attempt to reduce cephalin with hydrogen was at first unsuccessful, but lately reduced cephalin has been prepared. Various derivatives, especially urethanes, were prepared, but these were unsatisfactory because of their amorphous nature and threw no light on the composition of the body in question. Very recently Levene has been able to show that it is probable that during the process of purification there is a certain decomposition of the cephalin molecule and that one fatty acid radical is split off. Either this is the explanation or there occur in the brain two cephalins, one of which contains two fatty acid residues, while the other contains only one.

The cerebrins are a much more satisfactory class of compounds as regards work in the laboratory. They crystallize readily from alcohol and other solvents. Here again we find that we are dealing with a mixture of two substances. By careful fractionation from a number of solvents one is able to obtain a more insoluble fraction, which is found to contain only cerebronic acid. Cerebonic acid is a hydroxy-acid which contains twenty-five carbon atoms, and which on oxidation yields lignoceric acid. Lignoceric acid is familiar to some of us because it has been isolated from the soil and from wood. The other components of this more insoluble fraction, which has been given the name phrenosin, are galactose and sphingosine. Galactose is of course a well-known sugar. Sphingosine has been shown to contain seventeen carbon atoms, two hydroxy groups and one amino group, together with an unsaturated bond. By oxidation of sphingosine it is shown that the unsaturated bond is between the thirteenth and fourteenth carbon atoms, since the product of oxidation was tridecylic acid. Upon reduction and subsequent oxidation pentadecylic acid was obtained. This indicates that the amino and hydroxyl groups are located on the last three carbon atoms. Various attempts have been made to prepare the unsubstituted amine from sphingosine in order to locate the relative positions of the hydroxyl and amino groups. These efforts have been unsuccessful thus far. It has generally been assumed that the amino group is on the last carbon atom, and we may, therefore, express the formula for sphingosine approximately as follows:

$$C_{12}H_{25}CH:CHCH(OH)CH(OH)CH_2NH_2$$

The more soluble fraction of cerebrin (cerasin) becomes richer in lignoceric acid as the process of purification proceeds, and since we find no other substance upon hydrolysis, we may assume that the only difference between phrenosin and cerasin is in the nature of the fatty acid. It is, of course, desirable that an absolutely pure cerasin containing 100 per cent of its acid as lignoceric acid should be isolated. We may write the general formula of these compounds as follows:



Upon hydrolysis of sphingomyelin we obtain the following products: Sphingosine, identical with that obtained from the cerebrins, choline, phosphoric acid, and a mixture of fatty acids, one of which is lignoceric acid. The other acid appears to have the composition of a hydroxy-stearic acid, but this is not definitely established because of the difficulty in obtaining this acid in a pure state. It is still an open question as to whether there are two sphingomyelins, one containing cerebonic acid and the other hydroxy-stearic acid, or whether the molecule is a diphosphatide containing both of the fatty acids mentioned.

It is thus seen that the chemistry of the lipoids offers

a large number of unsolved problems. The difficulties in the field are many. The materials are very similar in physical and chemical properties, and are particularly hard to separate because they are so nearly neutral in character. If there was an acid or a basic group from which to prepare characteristic derivatives the hope of separation should be infinitely greater. As it is, one is dependent entirely upon very slight differences in solubility in mixtures of organic solvents. The losses in these fractionations are very great, and it is only when we work with kilograms of the material that we can hope for any success. Even with all of these difficulties, the field is a fascinating one and still offers an opportunity for a real contribution to our knowledge of physiological chemistry.

The British China-Clay Industry

There are signs that the china-clay export trade of England is beginning to revive after the severe blow dealt it by the war and by the exchange and transport difficulties that have hindered its development since the armistice. No other country possesses deposits of china clay similar in character and essential qualities to those found in Cornwall and Devon, although the United States, Germany and Austria have developed their native white earths for use as a substitute for china clay in certain classes of goods. The total production of china clay in Great Britain before the war was approximately a million tons per annum, but the trade is capable of considerable expansion.

England is the only country that exports china clay, the white earths of other countries being in no demand outside their centers of origin, and only to a limited extent there. Roughly, two-thirds of the British trade is export. Of the total production of 964,000 tons in 1912 (the last normal year, 1913 having been the year of the clay strike) over 661,000 tons were exported. In 1917 the total production dropped to 508,152 tons and the export trade to 310,750 tons, while in 1918 the production dropped to 465,325 tons and the export to 232,464 tons. Last year the export rose to 286,543 tons. During the later months of the war the exports to Russia, Germany, Belgium, and the Netherlands, representing in 1914 over 177,000 tons, were wiped out, except for 1,000 tons in 1918, and the exports to America had dropped by more than half—from 320,000 tons in 1914 to 152,000 tons in 1918.

Regaining of American and European Trade

The utilization of American kaolins by manufacturers of the United States has been artificially assisted through war-time freights inflating the price of English china clay, but with the gradual return of freights to normal the regaining of the American market by British clay shippers is only a matter of time. Recent big shipments seem to point to this being the case. As the American market accounts for nearly half of the normal china-clay export trade of the United Kingdom, and was actually more than half in 1914, it is important to the British industry that this business be recovered.

As to the European trade, here again the question of price may have a temporary influence against the recovery of some former markets, especially in countries which possess white earths capable of being used in certain classes of goods, but eventually the superior quality of English china clays will assert itself. Higher production costs in labor and material have forced up china-clay prices to a figure to which exporters are making every effort to accustom their former customers, and the gradual rise in the export trade points to the success of their efforts.

Continental Stocks Exhausted—The Home Trade

The export trade has a lot of leeway to make up before it attains to the normal. In 1912 Russia took 45,000 tons, and there has yet to be recovered the pre-war trade of 94,000 tons to Germany, 67,000 tons to the Netherlands, 58,000 tons to Belgium, 45,000 tons to France, and 21,000 tons to Italy, let alone the 40,000 tons to other foreign countries and the 35,000 tons to British possessions. There is this encouraging feature —that all the stocks of china clay on the Continent are practically exhausted, and that the replacement of those stocks, apart from running supplies, must absorb large quantities in the very near future. [The annual exports of unmanufactured china clay from the United Kingdom to all countries since 1913 have totaled: 1913—629,703 tons, value $3,617,902; 1914—628,620 tons, value $3,677,585; 1915—333,964 tons, value $2,085,709; 1916—393,893 tons, value $2,567,069; 1917—310,750 tons, value $2,339,078; 1918—232,464 tons, value $2,258,786; and 1919—286,543 tons, value $3,712,843. For the first three months of the present year the shipments amounted to 90,236 tons, valued at $1,186,419.]

The home trade also reveals hopeful signs. With the paper mills going at full blast to overtake a large accumulation of unfilled orders, the potteries busily engaged in meeting big demands from abroad, the "boom" in the cotton-textile trade, and the requirements of the chemical trades—all of which industries use china clay at some stage of their work—there is every reason for anticipating a revival approaching pre-war dimensions in the china-clay trade of Great Britain this year.

Fire-Resistant Coatings for Wood*

Fire-retarding paints are the most practical means so far discovered by which small amounts of wood can economically be made fire resistant. The only other known methods of decreasing the flammability of wood are to keep it wet, or to inject into it certain chemicals under pressure. These methods, though more effective than painting, are usually either impracticable or too expensive to be considered.

Ordinary calcimine or whitewash has proved in tests to be as fire resistant as any paint covering tried. It is cheap and convenient to use. Although it will not prevent the burning of wood exposed continuously to a high heat, a good coat of calcimine on wood will decrease the danger of a blaze spreading from burning cigarettes, sparks, matches and similar small sources of fire. Calcimine is, of course, more effective for inside than for outside use.

For exterior use numerous patented fire-retardent paints are available. An effective outdoor paint which has been developed at the Forest Products Laboratory consists of linseed oil, zinc borate and chrome green. This paint has maintained its fire-resisting properties through more than three years of exposure to the weather.

*From Forest Products Laboratory *Technical Notes*, June, 1920.

New Regulations for the Importation of Dyestuffs, Drugs and Chemicals

THE War Trade Board section of the Department of State announces that General Import License PBF 57 (War Trade Board Ruling 825, issued Aug. 15, 1919) as revised and extended now permits the importation into the United States from all countries of the world without individual import licenses of all commodities excepting synthetic organic drugs, synthetic organic chemicals, dyestuffs, products derived directly or indirectly from coal tar, including crude and intermediate products and mixtures and compounds of such products. For the importation of the commodities for which individual import licenses will continue to be required, new regulations have been made, as follows:

All applications for licenses must be made in triplicate on Form M provided for the purpose. The rules and regulations must be complied with strictly.

Dyestuffs From Germany

Licenses for the importation of dyestuffs of German make or origin similar kinds or satisfactory substitutes of which are unobtainable in the United States on reasonable terms as to price, quality and delivery may be granted in limited quantities for use of consumers to meet their own special manufacturing requirements, in conformity with special rules and requirements, as follows:

A letter stating clearly the requirements must accompany the application for license. Allocation certificates must be secured from the War Trade Board Section. On request special forms will be furnished consumers for application for allocation certificates, which when granted will entitle the consumer, on import application therefor to the War Trade Board Section, to licenses for the importation of such German dyestuffs as may be enumerated on the allocation certificates. Such certificates must be transmitted to the War Trade Board section with completed import applications (Form M) for licenses in order to receive attention. Allocation certificates, at the option of the consumer, may be indorsed over to an importer or other person to accomplish such importation, in which case the indorsee should complete and transmit import application (Form M) accompanied by corresponding allocation certificates to the War Trade Board section.

Dyestuffs From Non-Enemy Sources

Import application (Form M) for licenses for the importation of dyestuffs and for intermediates entering into the manufacture of dyestuffs of non-enemy manufacture must be confined to quantities not in excess of six months' manufacturing requirements and must be accompanied by affidavits or signed statements from ultimate consumers to the effect, if true, that the dyes, indicating them, in the quantities asked for are not in excess of their manufacturing requirements for a period of not exceeding six months from the date of receipt, and agreeing to notify the War Trade Board section of the date of their receipt. In completing import applications for licenses definite information must be furnished showing the name of the country in which the dyestuffs or the intermediates were produced and the name and address of the producers in order to have applications receive attention.

Synthetic Organic Drugs and Chemicals From Germany

Licenses are not being granted for the importation into the United States or its possessions of synthetic organic drugs or synthetic organic chemicals of German make or origin if the same drugs or chemicals or satisfactory substitutes are obtainable in sufficient quantities from domestic sources on reasonable terms as to price, quality and delivery to supply domestic requirements. Accordingly, applications for licenses for the importation of such commodities from Germany or of German make must show the chemical as well as the trade name, or the chemical character or composition, as may be, of each article, together with all other information available which will serve to aid in its identification, including the statement, if true, that the article or a satisfactory substitute for the purpose is unobtainable in the United States, or if obtainable, is unobtainable either in sufficient quantities or in required quality or at reasonable terms or delivery; further, that the quantity asked for is not in excess of six months' requirements for domestic consumption. Quantities of these commodities for consumption in manufacturing plants must be accompanied by affidavits or signed statements from the ultimate consumers along the lines indicated. Appropriate statements in accordance with the foregoing from three or more reputable physicians should accompany import applications for licenses for the importation of drugs and medicines of German make or origin.

Synthetic Organic Drugs and Chemicals From Non-Enemy Sources

On receipt of import application (Form M), accompanied by appropriate statements that the quantities are not in excess of six months' requirements for their own use or for purposes of sale to the trade, consideration will be given the matter of granting licenses for the importation, in limited quantities aforesaid, of synthetic organic drugs and synthetic organic chemicals of non-enemy make. Definite information must be given in the import application showing the name of the country in which the drugs or chemicals are produced and the name of the producer abroad, together with the statement that no part of the goods are of German make or origin.

Shipment of Controlled Commodities Prior to Obtaining License

Licenses for the importation of controlled commodities should always be obtained in advance of placing orders, and failure so to do cannot be accepted as a valid reason for granting licenses for the importation of any such commodities through any waiver of the rules and regulations governing such importations.

Native Drugs and Chemicals

Native drugs and chemicals in their earthy state, as mined or grown, and which have been subjected to no chemical treatment whatever, may now be imported into the United States from any country in the world without a license, the same as before the war, and no formalities are now necessary with the War Trade Board section in connection with the importation of such commodities.

Cracks in Ingots

A Demonstration That One Class of Deep-Seated Cracks Is Due to the Generation of Parasitic Centers of Crystallization in Undercooled Regions of the Melt, With the Result That Adjoining Phenocrysts Are of Widely Different Composition

BY FEDERICO GIOLITTI

CRACKS in ingots and castings are the principal things to avoid in steel-casting practice. Without attempting to classify and discuss exhaustively the kinds of defects which appear from time to time, it is sufficient to point out that some of them result from purely chemical phenomena, which develop as a rule during furnace work, while others are caused by distinctly physical reactions ordinarily arising during solidification and cooling of the metal. Inclusions of slag and blow holes belong to the first category; surface and internal cracks, on the other hand, are more commonly thought of as being due to differential thermal expansion during cooling through the solidification and transformation range.

IMPORTANCE OF LOCAL UNDERCOOLING

These phenomena have been carefully studied, but only in a few cases have their exact causes been determined. Unfortunately, flaws and cracks, though of the greatest importance, have been almost exclusively ascribed to hypothetical "internal stresses." This point of view has been accepted with such faith that in many cases internal stresses or a fancied adhesion of ingot to mold has been said to cause surface cracks!

I am convinced that the phenomena of local undercooling and of segregation and their effect on intercrystalline adhesion are far more important than internal stresses in originating flaws in metal, which in turn render the forging or other working of large masses of steel so delicate. Since illustrative cases where defects can be definitely ascribed to certain particular causes are not frequently met with, I believe that it is important that every such instance should be given wide publicity. The following observations, therefore, previously printed in part in *L'Industria*, vol. 29, Nos. 16 and 17, refer to a special case, analogous to many others which have come under my observation, where the interrelation is especially clear between the process of crystallization, its accompanying segregation, and surfaces of deficient strength in the steel.

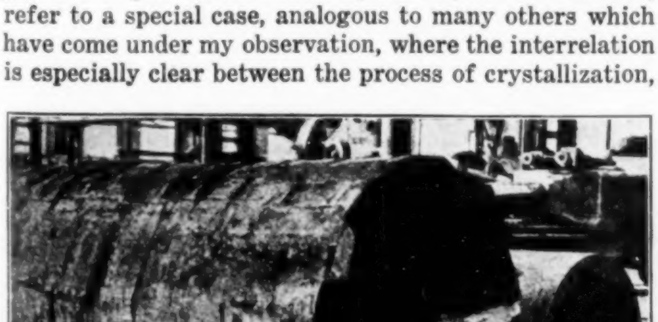


FIG. 1. TRANSVERSE CRACK NEAR BOTTOM OF INGOT

DISCOVERY OF EXTENDED CRACKS

A 50-ton nickel-steel ingot of the following composition was cast from an acid open-hearth in an octagonal cast-iron mold.

C	0.36	S	0.002
Mn	0.69	P	0.024
Si	0.27	Ni	2.02

Before the ingot was completely cool, it was placed in a reheating furnace, then roughed in a press to a cylinder of diameter but little smaller than across flats, and the top and bottom cropped. Even this early in the history of the piece there appeared some of those baffling defects which certainly are not *exclusively* due to differential thermal expansions. For instance, Fig. 1 shows a thin crust of considerable area which peeled off parallel to the bottom cut, curling out on itself, evidently indicative of a plane of little strength along the parting. Other such surfaces were later found in the same metal.

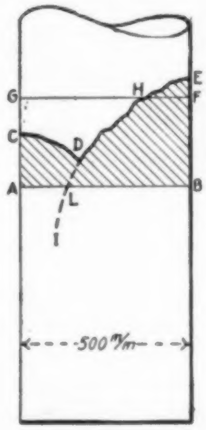


Fig. 2. Sketch of crack across axial core from ingot shown in Fig. 1.

After rough pressing and cropping, a cylindrical core about 500 mm. diameter was cut longitudinally down the axis, which on removal was found to be broken in three parts by irregular cross-fractures. Splitting the end of the core along an axial plane gave a block whose intersection with the lower break is sketched in Fig. 2 by the line *CDE*. A cross-cut *AB* then produced a sample for examination. After careful polishing and etching this surface for about 3 hr. in a 20 per cent H_2SO_4 solution at 60 deg. C., macrostructure of the portion shown cross-hatched in Fig. 2 immediately gave a clue to the cause of failure along an extension of plane *LD*.

Under eye examination, the most evident fact was the notable difference between the structure of part *ACDL* and part *LDHB*. In the left hand part clearly defined large dendrites were well developed, while on the right of *LD* a poorly defined granular structure existed, and the line *LD* itself was well marked by deep pits. All these characteristics were intensified by etching an hour longer, when the appearance was photographed in Fig. 3. Even further extended acid attack did not alter the essential appearance, but even emphasized the difference in structure and dug deeper into the metal at the common boundary.

Under microscopic examination, Fig. 4 shows the structure of the left-hand part, while Fig. 5 shows that of the granular structure immediately adjacent to the

FIG. 3. DIFFERENCE IN MACROSTRUCTURE IN ADJOINING PORTIONS OF INGOT

right (part *LDHB*) after repolishing and etching with at 5 per cent HNO_3 solution in amyl alcohol. The contrast between the relative areas occupied by ferrite and pearlite is extreme. Chemical analysis confirmed the fact that carbon was lower in the right-hand phenocryst, and that the average metal as tapped from the furnace was intermediate:

	Mass *ACDL* (Dendritic)	Analysis of Heat	Mass *LDHB* (Granular)
C	0.44	0.36	0.30
Si	0.26	0.27	0.24
Mn	0.70	0.69	0.62
P	0.034	0.024	0.018
Ni	2.09	2.02	2.03

Manganese and phosphorus are distributed in the same direction as carbon, but not to as wide an extent. Silicon and nickel are substantially uniform, the analytical results being within the limit of error, but even in these cases the dendritic mass seems to have a slight preponderance. Nickel, it should be remarked, diffuses in molten metal with known tardiness, so that it is possible that the heat analysis—made from a 30-kg. ingot taken from the molten stream at about the middle of the tap—may not correspond exactly to the mean concentration of nickel in the ingot.

Cause of Intense Segregation

These data seem to me to indicate clearly the cause of the demonstrated segregation. It is quite significant that the differences in concentration between the dendritic and the granular masses are greatest for those very elements with the greatest difference in composition between the solid and liquid phase at given temperatures during solidification.

A glance at the binary equilibrium diagrams between iron and the usual alloying elements establishes this point. Howe's diagram for carbon (Fig. 6) and Konstantinow's for phosphorus show a very considerable spread between liquidus *AB* and solidus *AE*. A vertical ordinate in the solid-solution range would have a quite long section between intercepts with *AB* and *AE*—which corresponds to the fact that a wide temperature range is traversed between incipient and completed solidification. In addition to this, a horizontal abscissa between 1,500 deg. C. and eutectic temperature would also have a comparatively long portion between intersections, denoting a wide difference in concentration between solid

FIG. 4. MICROSTRUCTURE OF DENDRITIC MASS

FIG. 5. MICROSTRUCTURE OF GRANULAR MASS

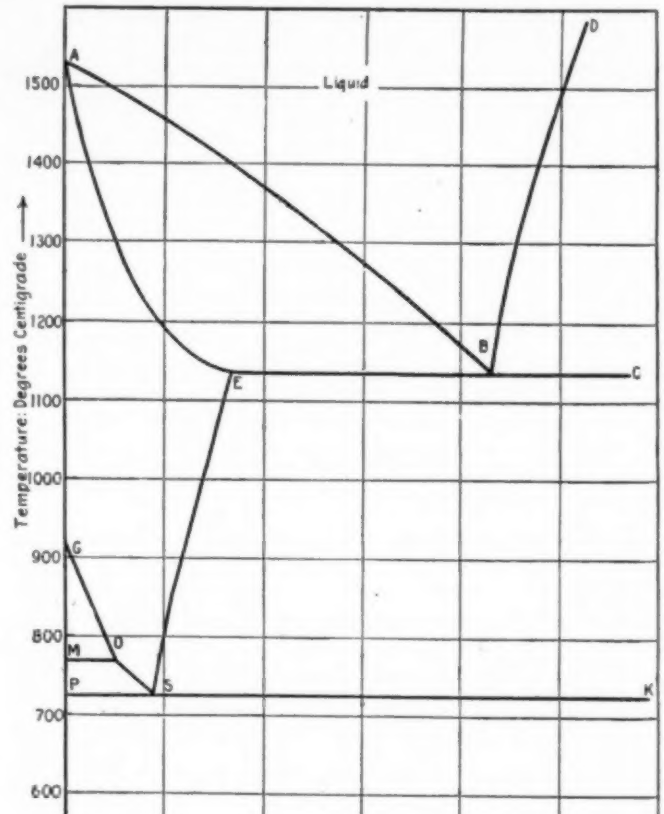


FIG. 6. IRON: CARBON EQUILIBRIUM DIAGRAM ACCORDING TO HOWE[1]

solution and liquid phases in contact and equilibrium at that degree. Segregation of manganese is much less, and the iron: manganese equilibrium diagram shows a smaller spread between liquidus and solidus (Fig. 8), while those alloys which have a yet narrower solidification range—iron: silicon shown in Fig. 9 and iron: nickel in Fig. 10—produce a negligible difference in the analyses.

Such facts are clear indications that the real cause of the internal discontinuity is inherent in the mechanism of separation of solid solutions from the melt.

In the particular case under discussion, the fact that the transition from metal of one composition to that notably lower in carbon and manganese occurred

[1] "Metallography of Steel and Cast Iron," p. 130.

in an interval of a few millimeters certainly suggests that two crystalline masses must have formed and developed around two different nuclei at different times or rates, and their growth was only arrested by coming into contact with each other, which surface of contact is well developed by the line *LD* in Fig. 3. Considering the size of the phenocrysts, it is evident that but few abnormal or parasitic germs of primary crystallization must have been generated in the interior of the fused metal. Proceeding from these nuclei, large crystalline masses grew into being, whose chemical composition

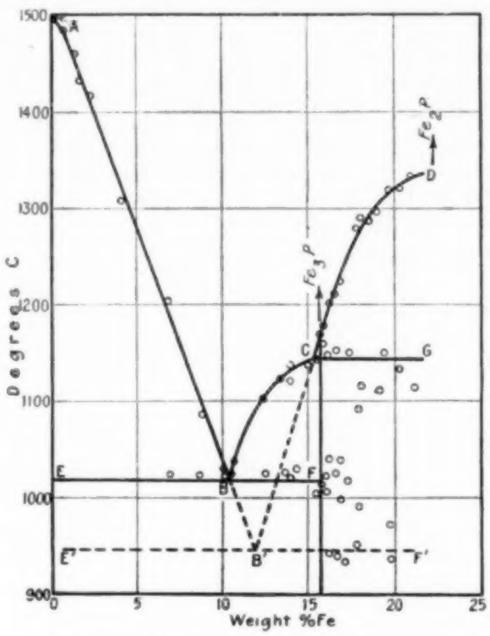


FIG. 7. IRON: PHOSPHOROUS EQUILIBRIUM DIAGRAM ACCORDING TO KONSTANTINOW[2]

varies, center to surface, in an analogous manner to that ordinarily found from the periphery to the axis of an ingot, or from the base toward the head, when crystallization is initiated at the sides and bottom. It seems clear that if two parasitic nuclei appear near each other at different times, or even if two simultaneous germs received accretion at notably different rates owing to a pronounced localized undercooling in the neighborhood of one of them, the ultimate surfaces of contact will separate various stages in the development of the pheno-

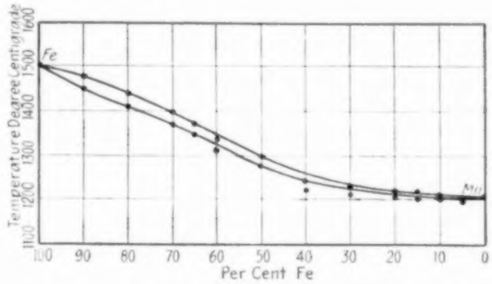


FIG. 8. IRON: MANGANESE EQUILIBRIUM DIAGRAM AT SOLIDIFICATION TEMPERATURES, ACCORDING TO LEVIN AND TAMMANN[3]

crysts themselves, and therefore different stages in the process of segregation with its attendant difference in chemical composition.

If it be granted that in this particular case the

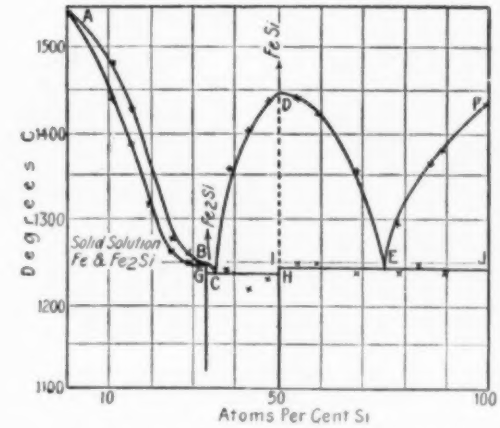


FIG. 9. IRON: SILICON EQUILIBRIUM DIAGRAM ACCORDING TO GUERTLER AND TAMMANN[4]

appearance of parasitic nuclei is responsible for a structural difference in no way connected with the geometric symmetry of the ingot, it follows from the well-known mechanism of solidification that such centers of crystallization will superpose an additional segregation effect upon that due to the ordinary columnar freezing of the main mass. In fact it may well happen that random nuclei may spasmodically appear well within the fused interiors of the mass, in a molten region which has already been enriched in alloying elements by the previous separation of purer solid solution at the superfices. Then the difference between the analyses of the central regions of several phenocrysts corresponding to various nuclei can be comparatively large, even

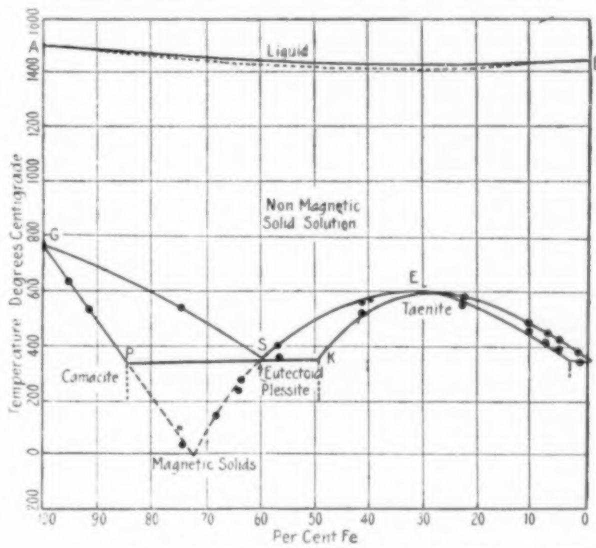
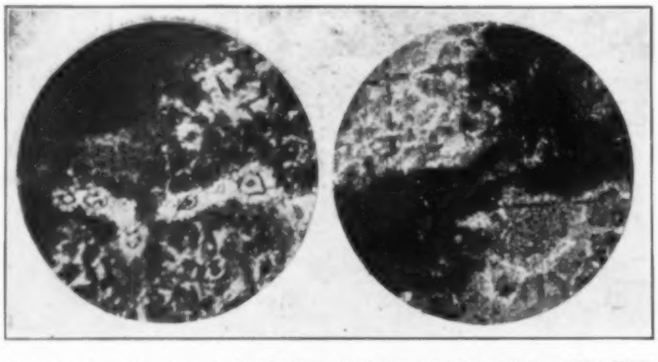


FIG. 10. IRON: NICKEL EQUILIBRIUM DIAGRAM ACCORDING TO OSMOND[5]

greater than the usual differences in concentration, edge to center, of an individual austenite crystal. This last conclusion seems to be verified by the analyses given above. While a minute chemical survey was not made, the macroscopic and microscopic examination amply demonstrates an extensive segregation *before* the formation of parasitic nuclei, a segregation much greater than is apparent within these phenocrysts themselves.

Cursory examination suggests that the contact surface *LH* has been impregnated with impurities. For instance, metal at and near the joint is attacked by

[2] *Z. anorg. Chem.*, vol. 66, p. 209.
[3] *Z. anorg. Chem.* (1905), vol. 47, p. 136, as reproduced in Gulliver's "Metallic Alloys."
[4] *Z. anorg. Chem.*, vol. 47, p. 163.
[5] *Compt. Rend.*, 1899, vol. 128, p. 304, and Gulliver, "Metallic Alloys," p. 331.



FIGS. 11 AND 12. NON-METALLIC INCLUSIONS AND DISCONTINUOUS STRUCTURE AT INTERCRYSTALLINE REGIONS

sulphuric acid with far greater speed than the body of the grains, etching the latter, but digging deep pits along the former. Microscopic examination of a polished surface confirms the impression, Figs. 11 and 12, showing the character of the non-metallic inclusions located there. Abundant foreign material agglomerated into masses of comparatively large dimension can be seen, much larger than those very small particles of "emulsified slag" which could occasionally be detected within the crystals themselves.

An analogous accumulation of slag and a similar agglomeration into masses notably greater than those found in other parts of the metal are frequently seen in the metal forming the walls of the pipe in steel ingots cooled very slowly; more especially in the proximity of the lower apex of this cone-like cavity. There seems no question that the metal forming the walls of the cone's apex is the last portion of the steel to solidify (at that region of the ingot, at least), and the commonly observed enrichment in insoluble impurities is habitually explained by the assumption that the slag particles, originally distributed in suspension in a substantially uniform manner throughout the melt, are gradually expelled and accumulated in the residual mother liquor, remaining fluid until the end. In other words, the mechanism of slag accumulation is intimately connected with the process responsible for the increase in concentration of elements actually in true solution in the fused steel, and which solidify in primary solid solutions in iron of a concentration less than that which exists in the liquid phase with which they are in equilibrium.

Whereas the separation of mixed crystals has been studied in detail, and there seems to be substantial agreement as to its modus operandi, certainly so much cannot be said as to the extrusion of suspended slag. Still, the explanation just advanced is in conformity with various researches to be published later. But accepting it as a fact that, in cooling, slag particles are accumulated in some manner or other in that part of the ingot last to solidify, it would seem justifiable to call upon a similar train of events to explain the presence of slag particles at the crystalline boundary *LH*, and to consider the cementing metal as the solidified last residue of liquid steel rich in impurities and slag, a mother liquor filling the voids between crystalline intersections.

Cracks Unrelated to Piping

It should be evident for three main reasons that the surface of weakness we are examining is not caused by the shrinkage pipe; first, because the fracture in question was but 800 mm. from the base of a 5-meter ingot; second, because the core cut from the ingot was sound and free from discoverable discontinuities for three meters beyond the fracture *CDH*, at which point appeared the bottom of the pipe; and third, the surface of weakness under examination traversed the ingot for more than half of its thickness, maintaining its characteristics for that distance without change.

But even if the pipe is related to similar defects, it would hardly alter the conclusions already reached relative to the influence of parasitic nuclei upon sound metal. Such germs evidently cannot form except in liquid metal occupying a core of indefinite size, walled by austenite crystals previously separated from the melt. They can appear simultaneously or in succession, but for maximum segregation it is highly probable that one center of crystallization sprang into existence considerably later than its neighbors, in some region where by reason of eddy currents, gas bubbles or non-uniform radiation the temperature was markedly different from the average of its surroundings. Once germinated, subsequent growth by natural crystalline accretion will account for all the abnormalities noted in the study of this ingot, especially if the phenomenon of undercooling or surfusion occurred before crystallization began, in which case the speed of growth is very largely increased.

Dangers of Such Variations in Composition

From a technical point of view, the consequences of large heterogeneities are essentially of two kinds.

First, notable differences in the carbon content of contiguous masses in the steel can render difficult or impossible the production of desired and expected results from a heat treatment predetermined for metal of the same average analysis and condition. In particular cases it is clearly impossible to follow general rules, and the best approximate thermal treatment must be studied individually. Practically, it is often the failure of steel parts to respond uniformly in the heat-treatment department which gives the first indication of large-scale segregation.

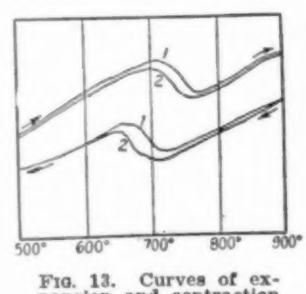


FIG. 13. Curves of expansion and contraction of adjacent crystals possessing considerable difference in composition

Second, as we have already seen in this study, the joint between metallic masses of different composition is ordinarily a surface of weakness which develops dangerous flaws. This weak bond, fracturing under mechanical work, is due primarily to the collection of impurities, and more especially slag inclusions, which originally were substantially uniformly distributed in the melt. Another very important cause of flaws lies in the differential thermal expansion of the adjacent phenocrysts, which effect is especially marked in the transformation range, where there evidently occurs what may be called a mutual "phase displacement."

As a concrete example of the last cause, I have prepared in Fig. 13 the expansion and contraction curves[6] characteristic of the two steels whose composition corresponds to that of the two parts adjacent to surface *LD* (Fig. 3). Upper curve 1 is expansion versus temperature for the low-carbon granular steel, while upper

[6]Obtained optically by the method described by Le Chatelier and Broniewski, *Revue de Métallurgie*, March, 1912, p. 133.

curve 2 is the same curve for the higher-carbon, dendritic metal. Lower curves 1 and 2 are the contraction curves respectively.

From these graphs it is at once evident that the change in volume with temperature on either heating or cooling is practically the same except when passing through the critical range. It follows that when the metal is cooling from 710 to 680 deg. C., one part of the metallic mass may be considerably shrunken while the other has suffered only a small change in volume. A corresponding effect, but to a much less extent, will occur when the procedure is reversed by heating.

Prevention of Large-Scale Segregation

It would be interesting to note the steps which have been taken at various steel works to prevent wholesale segregation by formation of parasitic nuclei, but the matter can only briefly be mentioned here. The writer is acquainted with very satisfactory methods in use at Italian plants largely occupied with munitions which have been maintained secret for several years, and which he is at liberty to mention only in general terms. It must suffice to say the following:

In the first place, one may select steels of such a composition that in them the greatest number of crystallization nuclei appear immediately below the formation of the first primary austenite crystals. Composition has a great deal to do with the existence of parasitic nuclei. Witness the fact that in a 20-point carbon steel containing 2 per cent nickel, manganese must be held lower than 0.4 per cent. If manganese by chance runs higher than this figure, the fact is immediately apparent in troubles with internal cracking at interfaces between crystals of widely differing composition. An important Russian plant utilizes the principle of cooling the steel through the mushy stage with extreme rapidity, while Americans habitually cast their metal at a temperature very close to the liquidus. I am informed that the Russian practice consists in casting in slightly conical molds; then as soon as the metal is walled in sufficiently to stand up, the mold is raised slowly, the hot metal being simultaneously drenched with pressure water from appropriate nozzles as fast as it is exposed. I also understand that a process of mechanically disturbed crystallization has been studied and applied successfully in at least one American plant making high-grade forgings. Such a system of stirring and jarring would work on the same principle utilized in salt technology, where crystallizing pans are equipped with stirrers when a uniform grain size is desired; quiescent cooling will cause extended supersaturation and the formation of crystals of widely differing mass.

Necessity to Record Observations

It would certainly be of greatest technical and commercial interest to collect and co-ordinate a sufficient quantity of experimental data that the crystallization criteria for various types of steels could be established with a fair degree of accuracy, following the general theory of Tammann. Data on the linear velocity of crystallization and on the number and distribution of crystallization nuclei appearing when the metal cools with differing speeds would be the most important. The relation between the width of the mushy stage and the generation of crystalline centers should also be studied. Such a systematic research would undoubtedly allow one to synthesize a procedure capable of preventing such segregation as that just illustrated; it would, however, present such great experimental difficulties as to render its successful conclusion very doubtful. It is therefore opportune to insist upon the importance of collecting the greatest amount of precise and complete data upon such defects as occur in regular works practice. From such a mass of evidence it may be quite possible to deduce the causes by an analysis of the concomitant circumstances, and so prescribe the necessary remedy, and even draw general conclusions of wide application. Certainly there are not lacking examples of complex technical processes—such as the chemistry of the open-hearth—which would be most difficult to elucidate by proceeding with synthetic studies in order to reconstruct the entire process on the basis of systematic data on the underlying elementary principles, yet it has been possible to reach very useful conclusions by following the opposite path, that is, by an analysis of the problem itself as it is in operation commercially.

Wood-Distillation Industry of Canada

The production from wood-distillation plants in Canada in 1918 (the latest year for which statistics are to be had) was valued at $7,634,122, this total including the item of $398,905 for repairs to machinery and plant made by employees.

There are thirteen plants, of which eight were located in Ontario and five in Quebec, with one refinery in each province. The amount of capital invested was $3,612,573, of which Ontario's portion was $2,321,881 and Quebec's $1,290,692.

The amount paid in salaries and wages to 675 male and two female employees was $731,435.

The charges for fuel of all sorts used during the year amounted to $839,966, of which $67,954 worth was of Canadian origin and $772,012 of foreign origin. Miscellaneous expenses totaled $365,789, and included such items as rent, power, insurance, taxes, traveling expenses and ordinary repairs to buildings and plant.

The quantity and cost of all materials delivered at the works during the year were:

Materials Used	Quantity	Cost Value at Works
Hardwoods, cords	128,097	$1,321,893
Lime, bushels	140,420	57,423
Crude wood alcohol for further manufacturing, gal.	1,081,837	1,071,227
Acetate of lime for further manufacturing, lb.	20,868,427	829,675
Caustic soda, lb.	186,900	7,709
Sulphuric acid, lb.	1,050,240	11,527
Soda ash, lb.	234,191	13,637
Other miscellaneous materials, lb.	445,986	6,640
Total		$3,319,731

The quantity and value of the various products of the industry at the point of production are given in the following table:

Products	Quantity	Selling Value at Works
Wood alcohol: Crude (sold as such), gal.	875,024	$981,535
Refined (sold as such), gal.	1,070,928	1,531,356
Acetate of lime, lb.	25,998,139	1,017,465
Acetic acid, lb.	1,772,223	170,173
Acetate of soda, lb.	295,572	51,389
Acetone, lb.	3,458,810	909,570
Formaldehyde, lb.	1,154,902	159,263
Ketone oils, lb.	792,864	211,440
Acetic anhydride, lb.	44,981	60,515
Methyl acetate, lb.	132,121	29,350
Charcoal, bushels	6,472,925	1,575,701
All miscellaneous products		537,460
Repairs to machinery and plant by employees		398,905
Total		$7,634,122

Properties and Constitution of Glues and Gelatines—IV

The Physical and Chemical Significance of "Craze" — Moisture Fluctuations — Relation of "Craze" to Nitrogenous Constitution—Studying Chemical Constitution by Determination of the Groups Characteristic of the Amino Acids—Purified Protein Analysis*

BY ROBERT H. BOGUE, PH.D.

SOME of the low-grade bone glues, after thoroughly drying out by exposure to the air for some time, craze badly. It is believed that this property of crazing not only detracts from the appearance of the glues and lowers their selling value, but also that a crazed product is of less strength in service than a glue of a similar grade which will remain firm. It seemed that an investigation of this peculiar property of crazing might reveal relations which would be of value both from the scientific point of view and from the standpoint of the manufacturer. This study was accordingly undertaken.

MOISTURE FLUCTUATIONS

It was noticed that in several instances low-grade glues would remain firm in the barrels, while those same glues in storage in the cabinet of samples would, after a short time, become badly crazed. This suggested that the water which such a glue would retain, after it had reached equilibrium with the air, was very likely a determining factor. To test this point several glues which were crazed in the cabinet but firm in the barrels were examined for water content. The results showed clearly that the cabinet samples had lost much more water than the firm samples in the barrels. The firm samples were then allowed to dry out in the air of the laboratory, and the water content determined at the time when crazing became apparent. This "critical moisture content" was found to be nearly, or slightly above, that found in the cabinet samples.

TABLE XXXVII. RELATION OF WATER CONTENT TO CRAZING

No.	Firm from Barrels	Crazed from Cabinet	Critical Moisture Content
1	16.06	11.04	11.36
2	14.98	11.36	11.84
3	16.98	11.24	11.44
4	16.98	10.88	11.52
5	16.10	10.84	11.24
6	15.80	11.14	11.54

It is apparent, therefore, that the water content of a glue that has reached equilibrium with the air is an important factor influencing the crazing of glues, for it seems that if the water content falls below a certain minimum amount, the low-grade glue will craze.

PROXIMATE ANALYSIS

It was known that of several glues of uniform grade, some would craze and others would not, even when equilibrium with the air had been reached. In order to ascertain if this fact were caused by differences in the proximate constituents of the glues, a number of glues of low grade, some of which were crazed and others not, were analyzed for water, ash, organic matter and nitrogen.

An examination of the results does not reveal any marked or consistent relation between the proximate constitution and craze.

TABLE XXXVIII. RELATION BETWEEN PROXIMATE CONSTITUTION AND CRAZE

	No.	Grade	Viscosity	Water	Ash	Organic Matter	Nitrogen
Crazed glues	1	B_7	43	12.74	3.74	83.52	14.58
	3	B_8	44	13.62	3.22	83.16	14.64
	5	H_9	46	12.34	3.57	84.09	13.98
	7	B_8	42	11.86	3.86	84.28	14.78
	9	B_9	42	10.72	3.55	85.73	14.60
	11	B_8	42	11.21	2.95	85.84	14.86
	13	B_9	43	11.44	2.56	86.00	14.52
Firm glues..	2	B_7	43	13.38	2.57	84.05	14.66
	4	B_8	44	12.18	4.12	83.70	14.95
	6	H_9	45	11.95	3.84	84.21	13.78
	8	B_8	43	11.20	4.24	84.56	14.72
	10	B_9	42	10.63	5.13	89.24	14.21
	12	B_8	42	11.86	3.29	84.65	14.10
	14	B_8	43	11.48	3.07	85.45	14.35
Average crazed..		B_8	43	11.99	3.35	84.77	14.56
Average firm....		B_8	43	11.91	3.75	84.44	14.39

RELATION OF CRAZE TO NITROGENOUS CONSTITUTION

Having found no relation between the proximate constitution of glue and the development of craze, the nitrogenous constituents, protein, proteose, peptone and amino acids were next determined in the same series, by the method described in a previous paper[60]. The data obtained are given in Table XXXIX.

TABLE XXXIX. RELATION OF CRAZE TO NITROGENOUS CONSTITUTION

	No.	Grade	Viscosity	Protein N	Proteose N	Peptone N	Amino Acid N
Crazed glues	1	B_7	43	47.4	41.0	9.8	1.8
	3	B_8	44	44.7	42.5	11.2	1.6
	5	H_9	46	52.6	35.8	10.8	0.8
	7	B_8	42	23.6	53.6	19.3	3.5
	9	B_9	42	30.5	53.0	13.9	2.6
	11	B_8	42	34.0	51.7	12.1	2.2
	13	B_8	43	39.3	45.5	12.8	2.4
Firm glues.	2	B_7	43	48.9	39.3	10.4	1.4
	4	B_8	44	44.0	43.2	11.0	1.8
	6	H_9	45	51.4	41.5	6.1	1.0
	8	B_8	43	33.6	51.9	11.8	2.7
	10	B_9	42	32.6	48.2	15.7	3.5
	12	B_8	42	35.4	51.4	10.9	2.3
	14	B_8	43	50.1	36.7	11.1	2.1
Average crazed..		B_8	43	38.9	46.2	12.8	2.1
Average firm.....		B_8	43	42.3	44.6	11.0	2.1

It will be seen from the data obtained that the firm samples are higher in protein and lower in proteose and peptone than the crazed samples. The amino acid nitrogen is about the same in the two sets. The grades and viscosities of the two sets are identical, as determined by the usual methods.

It was previously concluded[61] that the jell strength was determined by the ratio between the protein and its products of hydrolysis, the corollary of which would be that glues of the same jell strength would contain the

*For Parts I, II and III see CHEM. & MET. ENG., vol. 23, Nos. 1, 2 and 3, July 7, 14 and 21, 1920, pp. 5, 61 and 105.

[60]See Part III.

[61]See p. 107.

same amounts of protein. With the crazed glues, however, we find that glues of the same "grade" do not contain equal amounts of protein. The reason for this seeming contradiction lies in the limitations of the methods commonly employed for testing jell strength and viscosity. For example, grade B_4 will produce a very weak jelly in 1 to 5 solution; grade B_5 will not jell at that concentration. There may be a very wide variation in composition between those two grades. Again, the viscosity of most of these glues is 42 and 43. By the same instrument water has a viscosity of 42. Therefore, at such low values the composition may vary greatly before it becomes measurable by the apparatus usually employed.

The fundamental statement[62], therefore, that jell strength is proportional to the protein content is not contradicted. The crazed glues are actually a lower grade of glue, their jell strength is actually lower, even though it is not measurable by the usual tests, and they consequently contain a smaller amount of their nitrogen in the protein condition.

On correlating these observations with the previously determined fact that glues do not craze until they have been reduced to a certain minimum water content, it seems that the ability of a glue to retain water above a certain minimum amount depends upon its protein content. Crazing is therefore due to an exceptionally great hydrolysis of the protein molecule and the consequent inability of the resulting mixture to retain water above that minimum content below which crazing may occur.

On Chemical Constitution by Determination of the Groups Characteristic of the Amino Acids

The writer has shown[63] that the highest grade first run glues contain about 90 per cent of their nitrogen in the form of protein, while the lower grades, which are the last runs, may show only about 50 per cent of their nitrogen as protein. If the difference lay solely in the degree of hydrolysis of the same protein, it would of course follow that the ultimate nitrogenous constitution of the two would be identical. If, as seemed probable, the later boilings not only contain a larger proportion of their original protein nitrogen in a more or less hydrolyzed state, but have also obtained some of their nitrogen from a source differing from that of the original protein, then the ultimate nitrogenous constitution would probably not be the same in the two glues. The solution of this phase of the problem should be obtained by a nitrogenous analysis of the original glues.

It has been shown by Fischer[64] and many others that the protein molecule is made up of a number of amino acids, about twenty being known, and that these are linked together in the protein molecule by anhydride combinations between the amino group of one amino acid and the carboxyl group of another. Moreover, it appears that the characteristic physical and chemical nature of the different proteins is determined by the type and percentage of the several amino acids present in the molecule. It is, therefore, apparent that in order to make a comparison of the chemical constitution of the protein it is necessary to split them into their constituent amino acids. There is no method known by which the exact manner of combination may be found. Even the very sensitive anaphylaxis reaction is not invariably specific, as has been shown by Wells and Osburn[65]. Neither is there any method known by which each and every amino acid in the protein decomposition product may be determined quantitatively. They may all be isolated and identified by the esterification method of Fischer[66], but besides being very long and exacting the results are in no degree quantitative. The most careful work leaves from a third to a half of the protein molecule still unaccounted for. Hausmann[67] devised a method for the separation of the several groups of amino acids, and this principle has been extended and modified by Van Slyke[68]. By the utilization of this method one is able to separate the amino acids into eight groups, and this separation is quantitative.

The Method

The protein is first subjected to prolonged hydrolysis with hydrochloric acid, after which the ammonia is removed by vacuum distillation, and the melanin filtered off and determined from the Kjeldahl value. The "bases" arginine, histidine, lysine and cystine are then precipitated with phosphotungstic acid. These "bases" after separation from the filtrate are redissolved and determined by their marked chemical differences. Cystine is determined directly by its sulphur content, and arginine by decomposition of the molecule with strong potassium hydroxide. The molecule of arginine breaks up into a molecule each of urea and ornithine. The urea is decomposed into ammonia. None of the other bases are attacked. By determination of the total nitrogen and the amino nitrogen, the non-amino nitrogen is obtained. This is derived from the arginine, which contains three-fourths of its nitrogen in a form which does not react with nitrous acid, and from the histidine, which contains two-thirds of its nitrogen in non-amino form. The histidine nitrogen is, therefore, calculated by subtracting three-fourths of the arginine nitrogen from the total non-amino nitrogen, and multiplying the difference by three-halves. This is easily seen from the following equations, letting A = arginine nitrogen, H = histidine nitrogen, and N = total non-amino nitrogen:

$$\tfrac{3}{4}A + \tfrac{2}{3}H = N$$

$$H = \frac{N - \tfrac{3}{4}A}{\tfrac{2}{3}} = \tfrac{3}{2}(N - \tfrac{3}{4}A) = 1.5N - 1.125A$$

The lysine nitrogen is obtained by subtracting the sum of the nitrogen of the other three bases from the total nitrogen of the bases.

In the filtrate from the bases the amino acids are divided into two groups by a determination of the amino nitrogen and the total nitrogen; i.e., the acids containing only primary amino nitrogen; and those containing nitrogen in pyrrolidine or indole rings.

The eight groups, therefore, which are determined by the Van Slyke method are briefly as follows:

Ammonia, or amide nitrogen, considered to be derived from $-CONH_2$ or CONHOC- groups linked to the carboxyl groups of the dicarboxylic acids in the protein molecule (glutamic and aspartic acids).

Melanin, or humin nitrogen, from the dark colored pigment and slight amount of insoluble matter always formed in the hydrolytic products of acid hydrolysis of

[62] *Idem.*
[63] See p. 107.
[64] "Untersuchungen uber Amminosauren, Polypeptide, und Proteine," Berlin, 1899-1906.
[65] *J. Infect. Dis.*, vol. 12 (1913), pp. 341-358.
[66] *Op. cit.*
[67] Osburn and Harris, *J. Am. Chem. Soc.*, vol. 25 (1903), p. 323.
[68] *J. Biol. Chem.*, vol. 10 (1911), p. 151; vol. 12 (1912), p. 275; vol. 16 (1913-14), p. 121; vol. 23 (1915) pp. 23, 407.

proteins. It has been shown by Gortner and Blish[69] that "in all probability the humin nitrogen of protein hydrolysis has its origin in the tryptophane nucleus." They have found that when tryptophane was boiled with mineral acids in pure solution no humin was formed, but when tryptophane was added to a protein, or when carbohydrates were present, an abundance of humin was formed. They recovered up to 90 per cent of the tryptophane nitrogen in the humin fraction.

Cystine nitrogen.

Arginine nitrogen.

Histidine nitrogen.

Lysine nitrogen.

Amino nitrogen of the filtrate, which corresponds to

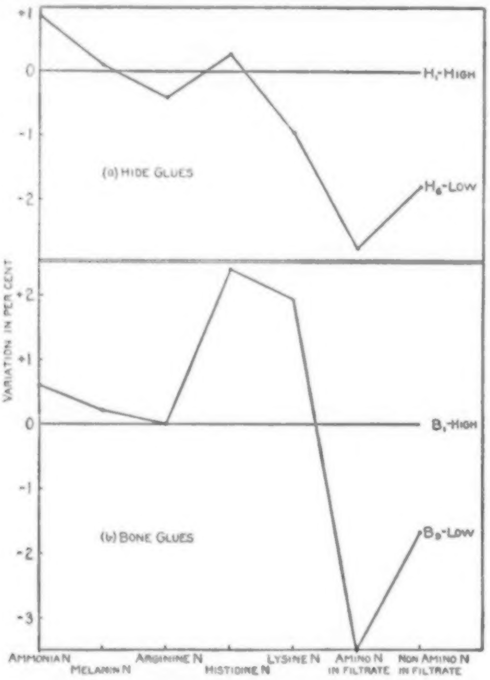


FIG. 18. VARIATION IN THE AMINO ACID CONSTITUENTS ON PASSING FROM THE HIGHEST TO THE LOWEST GRADE GLUES

all of the mono-amino acids except proline and oxyproline.

Non-amino nitrogen of the filtrate, which corresponds to proline and oxyproline, and some of the tryptophane. (Of the tryptophane which is not retained in the humin fraction one-half will appear as amino and one-half as non-amino nitrogen of the filtrate. In exceptional cases a portion of the tryptophane may also be precipitated by the phosphotungstic acid, and be calculated as histidine and lysine[70].)

EXPERIMENTAL

Hide and Bone Glues. This analysis was therefore undertaken, employing for the purpose all of the standard grade hide and bone glues. The results are expressed in Tables XL and XLI. Fig. 18 shows the variation between the highest and lowest grades of hide glue and of bone glue. Fig. 19 shows the variation between the average of the hide and of the bone glues.

The results may be summarized as follows:

The ammonia nitrogen increases as the grade decreases, and is decidedly higher in the bone glues than in the hide glues.

[69] *J. Am. Chem. Soc.*, vol. 37 (1915) pp. 1630-1636; and *Science*, vol. 48 (1919), p. 122.

[70] Van Slyke, *J. Biol. Chem.*, vol. 10 (1911), p. 40.

TABLE XL. HIDE GLUE ANALYSES[71]

Figures show per cent of total nitrogen in each fraction

	H_1	H_2	H_3	H_4	H_5	H_6	Average
Ammonia N	1.63	1.89	3.20	2.15	2.44	2.49	2.90
Melanin N	0.53	0.50	0.74	0.53	0.60	0.63	0.59
Cystine N	0.00	0.00	0.00	0.00	0.00	Trace	0.00
Arginine N	13.27	16.28	13.76	13.72	13.50	12.87	13.90
Histidine N	1.31	1.30	3.19	3.31	2.45	1.59	2.19
Lysine N	8.17	8.50	8.58	7.40	8.00	7.22	7.97
Amino N in filtrate	58.87	55.17	55.00	57.90	58.02	56.10	56.84
Non-amino N in filtrate	17.00	15.53	15.58	15.26	15.24	15.20	15.63
Total regained	100.78	99.17	100.05	100.27	100.25	96.10	100.02

TABLE XLI. BONE GLUE ANALYSES

	B_1	B_2	B_3	B_4	B_5	B_6	Average
Ammonia N	4.43	4.49	4.57	4.49	4.48	5.04	4.55
Melanin N	0.74	1.18	1.03	0.82	0.76	0.95	0.91
Cystine N	0.00	0.00	0.00	0.00	0.00	Trace	0.00
Arginine N	13.32	12.82	13.28	12.74	13.56	13.32	13.17
Histidine N	1.60	0.54	1.52	1.44	1.58	4.02	1.78
Lysine N	7.18	8.23	7.18	8.57	9.42	9.13	8.28
Amino N in filtrate	56.90	58.15	57.30	57.58	54.30	53.40	56.27
Non-amino N in filtrate	16.21	15.18	15.32	14.36	15.90	14.54	15.25
Total regained	100.38	100.59	100.20	99.80	100.00	100.40	100.21

TABLE XLII. ANALYSIS OF DOG HAIR AND GELATINE[72]

	Dog Hair	Gelatine
Ammonia N	10.05	2.25
Melanin N	7.42	0.70
Cystine N	6.60	0.00
Arginine N	15.33	14.70
Histidine N	3.48	4.48
Lysine N	5.37	6.32
Amino N in filtrate	47.5	56.3
Non-Amino N in filtrate	3.1	14.9
Total regained	98.85	99.02

The melanin nitrogen is nearly constant within each series, but it is higher in the bone than in the hide glues.

Cystine appears to be practically absent in all cases, traces only being found in two instances.

Arginine varies slightly from glue to glue, but shows

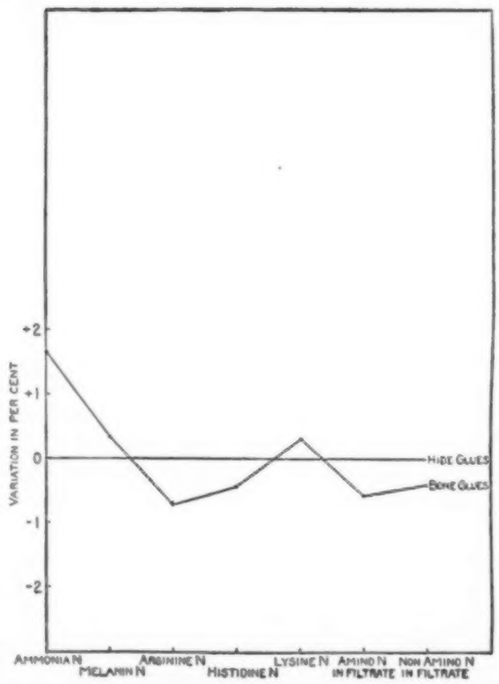


FIG. 19. VARIATION BETWEEN THE AVERAGES OF THE HIDE AND BONE GLUES

no consistent variation with grade. It is somewhat higher in the hide series.

Histidine varies irregularly, but is higher in the hide series except in the case of the pressure tankage from bones where it shows a maximum.

[71] The glues are arranged in order of decreasing jell strength.

[72] Van Slyke, *loc. cit.*

Lysine is fairly uniform in both series, increasing slightly, however, in the lower grades of bone glue.

Amino nitrogen of the filtrate is irregular in variation, but shows a tendency to decrease as the grade, especially in bone glues.

Non-amino nitrogen of the filtrate also shows a tendency to decrease as the grade, and is somewhat lower in the bone series.

Conclusions

Three conclusions may be drawn from the above summary of results:

There seems to be a sufficiently consistent variation from grade to grade in the case of a few constituents to justify the following conclusion: As boiling of the glue stock progresses, and under the influence of higher temperatures, some proteins of the stock will be hydrolyzed and brought into solution which were not at all or only slightly attacked during the first boilings. The first reaction is unquestionably the hydration of collagen to gelatin, but by the more drastic and continued extraction such substances as chondridin, keratin and mucin may be brought into solution. Whether or not the analyses as performed would show this point to advantage must depend upon the constitution and amount of these hydrolyzed substances so produced. If the constitution of the hydrolyzed chondridin, keratin or mucin were markedly different from that of gelatin, the presence of the former would be easily detected even in small amounts, but if the differences in constitution were but slight, their presence would be detected with difficulty by this method, even if present in large amounts. The only comparable analysis which has been made of any of these substances is one of dog hair, which is largely keratin, reported by Van Slyke[73]. This is given in Table XLII. When it is remembered that only the soluble portion could by any chance get into glue, thereby largely eliminating the high melanin fraction and raising certain other fractions accordingly, it will be seen that the divergence from glues is not striking. However, such differences as exist are in harmony with the variations that actually occur in passing from a high- to a low-grade glue, or from a hide to a bone glue. This does not prove that keratin is present in low-grade glues, but it suggests the possibility, and at least is not opposed to the hypothesis that some foreign proteins such as keratin have been hydrolyzed.

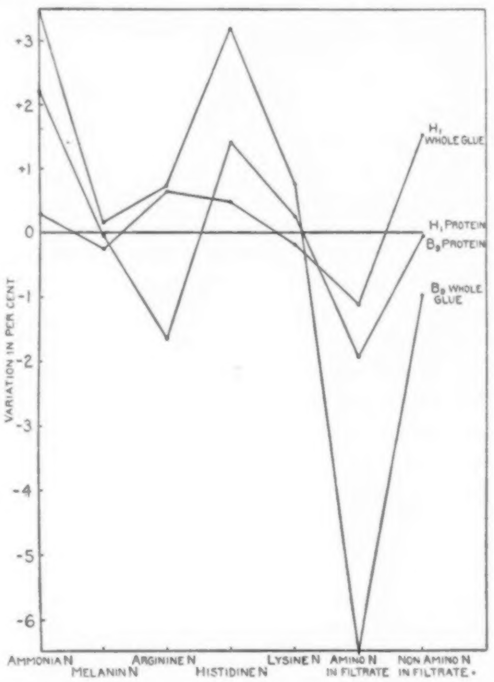


FIG. 20. VARIATION IN THE AMINO ACID CONSTITUENTS BETWEEN THE HIGHEST HIDE GLUE PROTEIN (H_1) AND THE PROTEIN OF THE LOWEST BONE GLUE (B_9). WHOLE GLUES SHOWN ALSO

[73] *Loc. cit.*, vol. 10 (1911), p. 47.

There is a sufficiently marked variation between hide glues and bone glues to justify the conclusion that the proteins from which they are derived are different, or at least that the ratio of the constituent proteins is different. This is shown most decisively in the ammonia fraction, it being much higher in every instance in the bone than in the hide glues. This indicates a higher content of the dicarbozylic acids, glutamic and aspartic.

The inconsistencies among the results may reasonably be laid to differences existing in original stock from which the several glues were made.

Purified Protein Analysis

In order to determine to what extent the difference between the hide and the bone glues was due to their protein content, as distinguished from the products of protein hydrolysis, a representative high-grade hide glue (H_1) and a low-grade bone glue (B_9) were each subjected to alcoholic precipitation by slowly pouring the dilute glue solution into cold 95 per cent alcohol, redissolving in warm water and reprecipitating four times. These purified proteins were then subjected to the same determinations as the original glues. The results are shown in Table XLIII, and the variations are expressed graphically in Fig. 20.

TABLE XLIII. PURIFIED PROTEIN, FISH GLUE AND ISINGLASS ANALYSIS

	H_1 Protein	B_9 Protein	Fish Glue	Isinglass
Ammonia N	1.33	3.57	5.15	3.98
Melanin N	0.78	0.74	1.12	0.68
Cystine N	0.00	Trace	Trace	0.00
Arginine N	12.61	10.96	13.80	14.20
Histidine N	0.82	2.24	2.04	2.33
Lysine N	8.34	8.60	8.58	6.06
Amino N in filtrate	60.00	58.05	60.20	58.65
Non-amino N in filtrate	15.49	15.47	9.66	13.59
Total regained	99.37	99.63	100.55	99.49

The differences between the constitution of these two purified proteins are still large, especially in ammonia, arginine, histidine, and amino nitrogen of the filtrate. However, they are not as great as existed between the original whole glues, and variations which previously existed, as in melanin, lysine and non-amino nitrogen of the filtrate, have disappeared.

Hide and Bone Glue Proteins

This seems to show that:

The proteins of the hide and bone glues are fundamentally different in some respects, and are unquestionably derived from protein complexes which are different, or in which the ratio of the constituent proteins is dissimilar.

This is corroborated further by the great difference in physical properties of the two purified proteins. That from hide glue is white, and forms very tough leathery masses which are not sticky, while the bone protein, although white at the moment of precipitation, very rapidly becomes brownish, and is a sticky, soft, gummy

mass. Repeated precipitations fail to alter these properties.

The constitution of the whole glues used varies more than that of the isolated proteins, which shows that even more of the "foreign substances" of bone glues, which reduce their value, are present in the proteose and peptone fractions than in the protein fraction.

Isinglass and Fish Glue

It has been claimed by some investigators that the soluble portion of Russian Sturgeon-sound Isinglass was pure gelatin. For the purpose of comparison it was decided to make a "Van Slyke analysis" of this substance. The results are given in Table XLIII. It will be seen that the arginine nitrogen is higher and the lysine nitrogen lower than in any other analysis. The ammonia nitrogen is high, and the non-amino nitrogen of the filtrate is low, but in general the figures correspond somewhat more closely to Van Slyke's analysis of gelatine[71], shown in Table XLII, than any other glue. It is also apparent that in most of the groups the high-grade hide glues more nearly correspond in value to the analysis of isinglass than the bone glues.

To obtain still further comparative data a fish glue was analyzed. The results are given in Table XLIII. This glue shows higher ammonia, melanin and amino nitrogen of the filtrate, and lower non-amino nitrogen of the filtrate than any other glue, but more nearly corresponds to the low-grade bone glues than to the hide series. Only in its high amino nitrogen of the filtrate does it resemble the latter. The very low non-amino nitrogen of the filtrate in the case of both of the fish products indicates a fundamental distinction from animal glues.

The variations of isinglass and fish glue from the highest grade animal glue protein (H_1) is shown in Fig. 21. The curve for the average of all animal glues is also included. It would seem from this that there is much difference between the constitution of isinglass and the pure animal protein, and if either one of these may be assumed to consist of pure gelatin, the other must of necessity contain considerable impurity.

Summary

The conclusions detailed in this section may be briefly recapitulated as follows:

Hide and bone glues vary slightly in their chemical constitution on passing from grade to grade. This is interpreted to signify that as the boiling of a glue progresses some "foreign substances" as chondridin, keratin, mucin, etc., become hydrolyzed and enter the solution. These have no value in glue, and by adulteration lower the value of the product.

Hide and bone glues differ from each other in their chemical constitution. This is taken to signify that the protein complexes from which the glues are derived are different in the two cases, or that the ratio of the several constituents is different.

Glues of different stock within both hide and bone series show a difference in constitution, which is attributed to variations in the protein complexes of the several stocks.

The differences between hide and bone glues are found in the protein fraction to a lesser extent, and in the proteose-peptone fraction to a greater extent than obtained in the whole glues.

[71] *Loc. cit.*

If the purified protein from the highest grade animal glues may be considered as pure gelatin, then it follows that isinglass is not a pure gelatin, or if the assumption be made that isinglass consists only of gelatin, then the purified animal glue protein contains impurities.

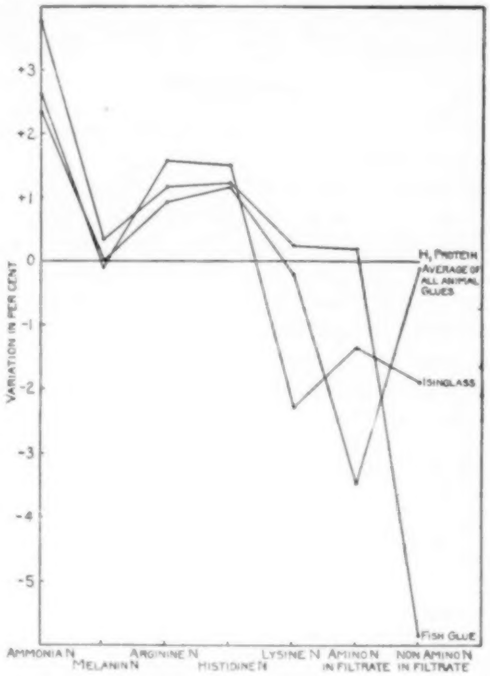


FIG. 21. THE VARIATION, FROM THE HIGHEST ANIMAL GLUE PROTEIN, OF AVERAGE ANIMAL GLUES, ISINGLASS AND FISH GLUES

The lower the grade of a glue, the further is it removed in constitution from that of the purified protein, and, if this protein be assumed to consist only of gelatin, then the gelatin content of glues diminishes with the grade, and the substance from which the hydrolytic products are obtained consists of gelatin in decreasing amounts, as the grade decreases.

Fish glue corresponds more closely in its composition to low-grade bone glue than to any other.

Fish glue and isinglass show a fundamental difference from animal glues in their low "non-amino nitrogen of the filtrate" (proline, oxyproline, and tryptoplane).

(Part V will be published in the next issue.)

Progress in Optical Glass Manufacture

Another triumph of American ingenuity is the manufacture of optical glass. Prior to the war practically all this material was produced abroad, but the cessation of imports and the great need of lenses for field glasses, telescopes, and other optical devices used in warfare, necessitated immediate investigation as to the possibility of optical glass manufacture in this country. Experiments were carried on and the process so successfully developed that not only the smaller lenses for field glasses but also the larger types which are used in telescopes were manufactured. Lenses up to 20 in. in diameter are now made and larger ones contemplated.

Great difficulty was experienced in the annealing process necessary to remove internal strains which cause the lenses to crack on cooling. To overcome this, however, a new electric furnace has been designed which gives a much closer control of temperature during the annealing, and one company soon expects to have all sizes of lenses up to 20 in. and over on the market.

The Evaporator Experiment Station at the University of Michigan*

An Account of the Institution of the Evaporator Laboratory — Description of the Vertical, Horizontal and Semi-Film Evaporators and Miscellaneous Equipment— Program of Investigations Proposed

By W. L. Badger and P. W. Shepard

THE subject of co-operation between industrial concerns and universities has been discussed so frequently that this general question will not be taken up here. It is proposed, however, to describe what is believed to be a very noteworthy case of such co-operation.

During the summer of 1917 the Swenson Evaporator Co., of Chicago, Ill., was considering the establishment of an evaporator experiment station to study both general theoretical questions and detailed concrete problems regarding evaporator design. The possibility and desirability of co-operation in this work with some university became apparent early in the development of the idea; and the matter was taken up with the Board of Regents of the University of Michigan. After a careful and extended discussion by both parties an agreement was reached substantially as follows:

The university furnished a suitable building, light, water, steam and power, and assumed responsibility of providing equipment for making all necessary measurements involved; this consisting of such articles as weighing devices, thermometers, gages, manometers, recording instruments, volumetric measuring devices, etc. The Swenson Evaporator Co. bore the entire expense of designing, building and erecting the machinery; and as soon as erected, its title passed to the University of Michigan. The whole station, then, is the property of the university and is available for instruction, demonstration and research. In return for this investment the university granted to the Swenson Evaporator Co. the right to carry out certain detailed investigations of its own, the right to maintain in this laboratory its own employees and the right to retain as its own property the results of certain specific classes of detailed investigation. It was expressly provided, however, that in case any facts of general scientific importance were developed, they were to become public property even though they were developed by the company's employees and at the company's expense.

Work Delayed by War

The design of the apparatus was immediately started, but its manufacture and delivery were greatly delayed due to conditions arising out of the war. Actual equipping of the laboratory did not begin till March, 1918. The principal equipment was added as rapidly as possible, but the final layout was not ready till August, 1919. Due to lack of graduate chemical engineering students during the war, the work so far has been largely carried out by the company's employees and at the company's expense. The two papers accompanying this description fall in this class. Acknowledgment is made to E. M. Baker, instructor in chemical engineering in the University of Michigan, who has taken an active part in the development of the laboratory and the prosecution of the research.

The principle adopted in planning the equipment was to make all units large enough to minimize personal errors and errors due to small-scale work. The station was to furnish data for actual engineering design—not only for evaporators but for entire plants and complete processes. Consequently all units installed were of commercial size, and results obtained in them are transferable quantitatively to full-scale commercial operation. Much thought was given to all possible problems, both general and specific, which might arise. Provisions were accordingly made for changing the set-up and connections, taking temperature and pressure measurements, and in general anticipating the requirements of the most varied and intricate work which could be expected. Attention was given to making it possible to secure ample data for every step of an experiment. Every problem, both general and specific, which the station takes up, is treated quantitatively. This is not only for the sake of collecting a general fund of information regarding the behavior of evaporators but also that all possible problems which might arise in development of the process experimented on might be forestalled.

Equipment Installed

Since the primary purpose was to study evaporator design, one representative of each of the three common types of evaporators was provided. Accordingly the station has a vertical tube, a horizontal tube and a film type evaporator following the standard designs of the Swenson Evaporator Co. for each type. To handle problems where crystals are deposited there is a salt filter which may be used on either the horizontal or vertical tube evaporator. To make possible the solution of the widest variety of problems, the heating surfaces of each evaporator were made easily removable and a wide variety of methods of disposing or arranging the heating surfaces was provided. Parts forming vapor belts were made interchangeable so that the main dimensions of the machines could be altered at will. Several types of bottoms were provided and made easily removable and interchangeable.

The station also possesses a number of storage tanks, so that several materials may be on hand at one time. Capacity is provided for storing a tank car of liquid. Pumps and pipe lines make all possible combinations available. One tank is provided with an agitator for making up solutions.

Operations of interest to the chemical engineer other than evaporation have not received as much attention as evaporation, but are being added rapidly. A filter,

*Read before the American Institute of Chemical Engineers, Montreal, June 29, 1920.

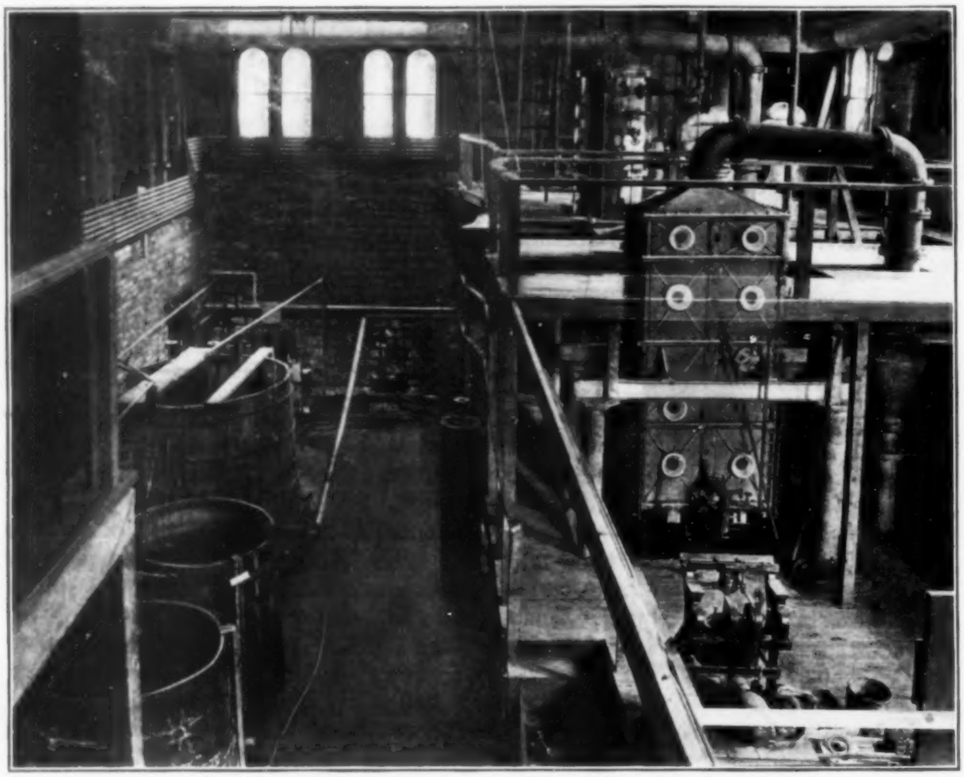


FIG. 1. GENERAL VIEW OF EVAPORATOR LABORATORY

a centrifugal, a crystallizer and a steam-jacketed kettle are now installed.

The station is housed in a building which was formerly the university power house. The old boiler room contains the laboratory proper. This is 65 x 35 ft. in plan; the floor is 15 ft. below ground level, and the roof extends in part to a height of 35 ft., giving ample head room. This room still contains the university's distribution system for steam, electricity and water, though the mains are now supplied from a new power house. A bunker 60 x 20 ft. is available for storage. The room is well adapted for the purposes of the work that will be done. In the front part of the building is an office and a drafting room for the use of the station staff. A good idea of this building is given in Fig. 1.

Vertical Tube Evaporator

The vertical tube evaporator (Fig. 2) is of the Swenson patented basket type. This choice was made not only because the Swenson Evaporator Co. was naturally most interested in this type of evaporator (as representative of vertical tube machines), but also because it made alterations of the heating surface much simpler. The body of the evaporator is of cast iron 30 in. inside diameter, and is built in 4-ft. sections. The bottom section carries connections for feed and wash water. Condensed steam from the basket is taken out through a stuffing box in this section. Intermediate sections have no pipe connections in ordinary operations. A pad is provided along one side of all sections. This carries a number of openings tapped for 2-in. and ¾-in. pipe. All ordinary connections are made through these openings, and such special piping as may become necessary is thus anticipated. The top section carries the steam connections. A 1½-in. line brings steam at about 100 lb. and a 3-in. line brings steam at about 3 lb. These unite in a "T" into a 3-in. line which passes through the top section and down the center of the evaporator to the steam basket. Some runs have been made with the top and bottom actions only, making the evaporator 8 ft. high. Most of the work has been done with one intermediate section, making the evaporator 12 ft. high. Another intermediate section is provided so that the evaporator can be carried to a height of 16 ft. if desired. The vapors are removed from the evaporator by a 10-in. cast-iron pipe to a wet parallel current condenser, which, instead of being mounted near the top of the evaporator, as is customary, is located on the operating floor so as to be available for test.

The steam baskets provided for this evaporator are all of 18-in. O.D. and carry twenty-four 2-in. charcoal iron tubes. They have a 3-in. central steam inlet and six ½-in. connections around the outside edge of the top head for manometer connections, etc. Condensed steam is removed by a 2-in. pipe flush with the bottom head. Four baskets are at present provided with

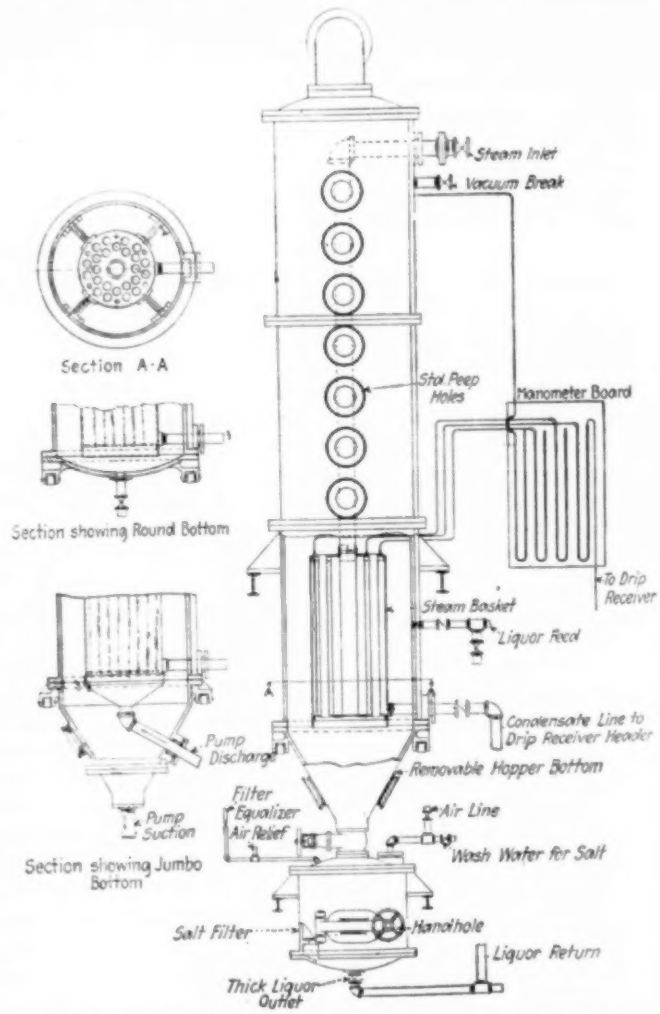


FIG. 2. DIAGRAMMATIC SKETCH OF VERTICAL TUBE EVAPORATOR

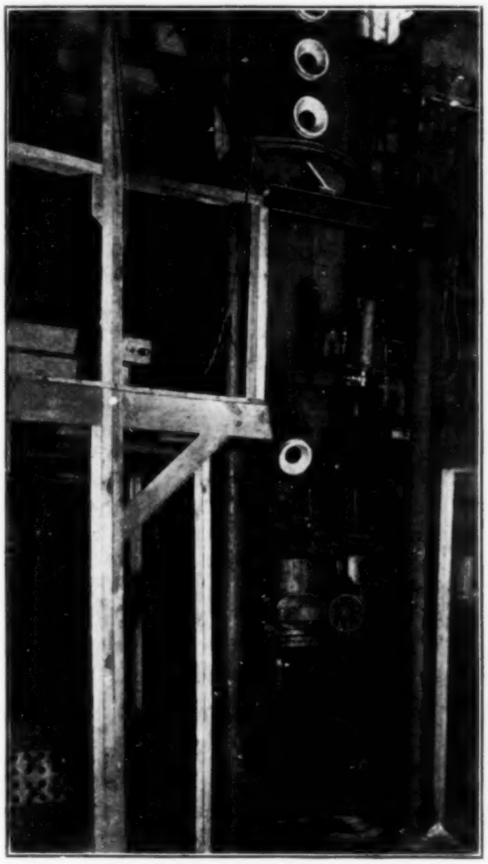


FIG. 3. VERTICAL TUBE EVAPORATOR WITH CONE BOTTOM AND SALT FILTER

tubes respectively 30 in., 48 in., 60 in. and 84 in. long. Baskets of this diameter give an annular down-take space of 6 in. This makes a very much larger ratio of downtake area to tube cross-section than is usual, but this was done purposely. The question of the proper value for this ratio is a rather important one on which no direct evidence is available. Sheet-iron filler cylinders are provided to reduce the diameter of the machine at the level of the steam basket so that the down-take ratio can be varied and the effect of changes in the ratio may be studied. This problem has not yet been taken up. The purpose of providing baskets of different tube lengths was mainly to study the question of ratio of tube length to tube diameter. Considerable work has been done on this, but the results will not be ready to report for some time.

The evaporator is provided with three bottoms—a flat bottom, a 60-deg. cone bottom, and a special cone bottom with provision for forced recirculation by an arrangement patented by the Swenson Evaporator Co. (called the "Jumbo" bottom). A salt filter, 24 in. in diameter and 18 in. high, is mounted on a truck at such a height that it may be connected by a 3-in. gate valve to the standard hopper bottom. Set screws in the brackets of this filter make its exact adjustment a simple matter. The filter is provided with monel metal screen held between two heavy perforated plates. (See Fig. 3.)

The evaporator is set so that the bottom flange of the lower section is about 8 ft. from the ground floor. An overhead trolley is provided for handling heavy parts. The various bottoms have brackets bearing rollers. Removable tracks may be quickly bolted to the columns which support the evaporator. When it is desired to change the bottoms on the evaporator, the tracks are put in place, the bottom which is in service is unbolted and lowered to the tracks (about 2 in.), rolled from under the machine and removed by the chain-falls. The new bottom is hoisted on the tracks, run under the machine and lifted into place by drawing up the bolts.

HORIZONTAL TUBE EVAPORATOR

The horizontal tube evaporator (see Fig. 4) is approximately 30 in. wide by 4 ft. long inside, made of ribbed rectangular cast-iron plates. The ends of the evaporator in ordinary commercial design are the tube sheets. In this evaporator, in order to make changes simple, the sides and bottom are assembled on a cast-iron frame called the front plate; and to this front plate is bolted the tube sheet. This makes it possible to change tube sheets, thereby permitting the study of such problems as varying the diameter of the tubes, varying their spacing, putting in circulation belts, etc. The tube sheets generally used take ⅞-in. O.D. tubes, on 1⅝-in. centers. This makes room for sixteen tubes in each horizontal row and twenty-eight in each vertical

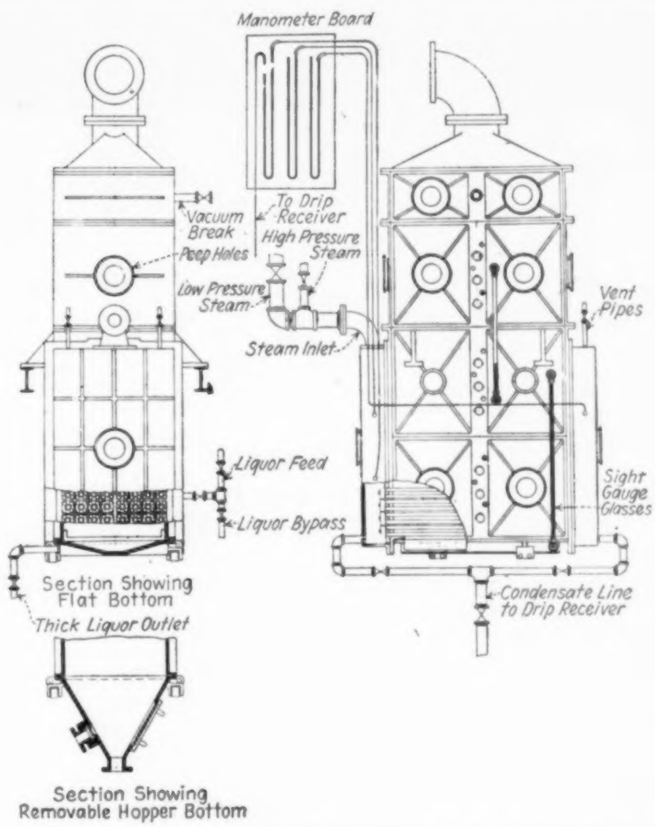


FIG. 4. DIAGRAMMATIC SKETCH OF HORIZONTAL TUBE EVAPORATOR

row. It is not intended that all these be used at once. Generally from forty to seventy-five tubes are used. They have an effective length of 3 ft. 10 in. and a heating surface of 0.75 sq.ft. per tube. The steam chests are cast box shape and have condensate drains from the bottom of each. Several vapor belts, each 27 in. wide, are provided, and the minimum height of machine is about 5 ft. This evaporator is also provided with a 10-in. vapor pipe, and its condenser is the same as the one on the vertical. Like the vertical evaporator, it is mounted on brackets so that the bottom is entirely unobstructed. It is provided with a flat bottom and also with a hopper bottom. It is set at such a height that when it is equipped with the hopper bot-

tom the salt filter which serves the vertical evaporator will fit it also. The salt filter is mounted on a truck, which makes it easy to transfer from one evaporator to the other. The hopper bottom is provided with a

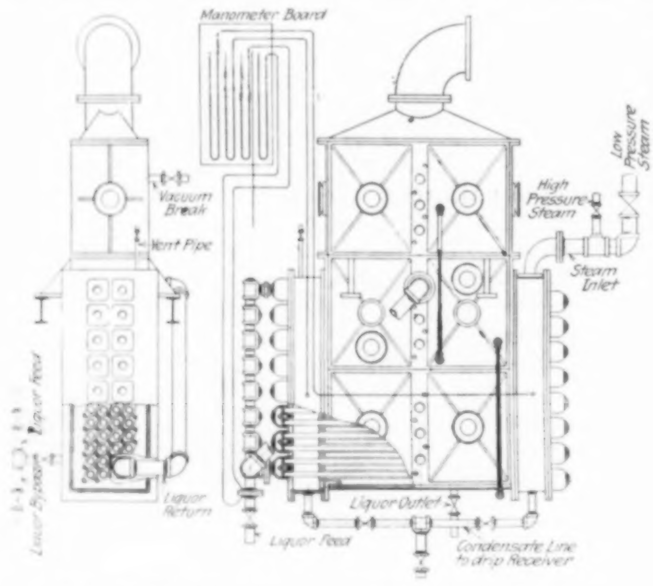


FIG. 5. DIAGRAMMATIC SKETCH OF SEMI-FILM EVAPORATOR

stuffing box so that the effect of forced circulation may be tried here also.

SEMI-FILM EVAPORATOR

This evaporator (see Fig. 5) is the third representative in the station and offers several interesting features. It is patented by the Swenson Evaporator Co. and is known as the company's "Type K" evaporator. It is primarily a horizontal tube evaporator similar to that just described except that it is only about 15 in. wide. It carries, however, 2-in. tubes. Corresponding to the steam chests of the horizontal tube evaporator are two steam belts, one on either end, and these steam belts, instead of being closed by a cover plate as in the ordinary horizontal evaporator, are closed by secondary tube sheets. These secondary tube sheets carry 1¼-in. tubes concentric with the 2-in. tubes in the primary tube sheet. These 1¼-in. tubes are connected in series on the outside of the evaporator by means of special return bends.

Steam is passed into one of the steam belts and thus enters the annular spaces between the 2-in. and the 1¼-in. tubes. The liquid to be evaporated is pumped into one of the return bends and circulated back and forth through all 1¼-in. tubes in the series. From the last return bend it is discharged into the body of the evaporator, where it is boiled by the 2-in. tubes as in an ordinary horizontal evaporator. It is possible in the operation of this machine to separate the inside tubes from the outside tubes and thus a very wide range of interesting problems is opened up.

CONDENSATE RECEIVERS

The whole subject of the basis for reporting the results of the station has been given careful consideration, and it has been decided to base all work on the actual heat transmitted rather than on amount of liquid evaporated. The latter plan obscures the results by introducing such factors as temperature of feed, loss by entrainment, radiation, etc. All these may be determined when desired; but the fundamental work is based on heat transmitted. Therefore the primary

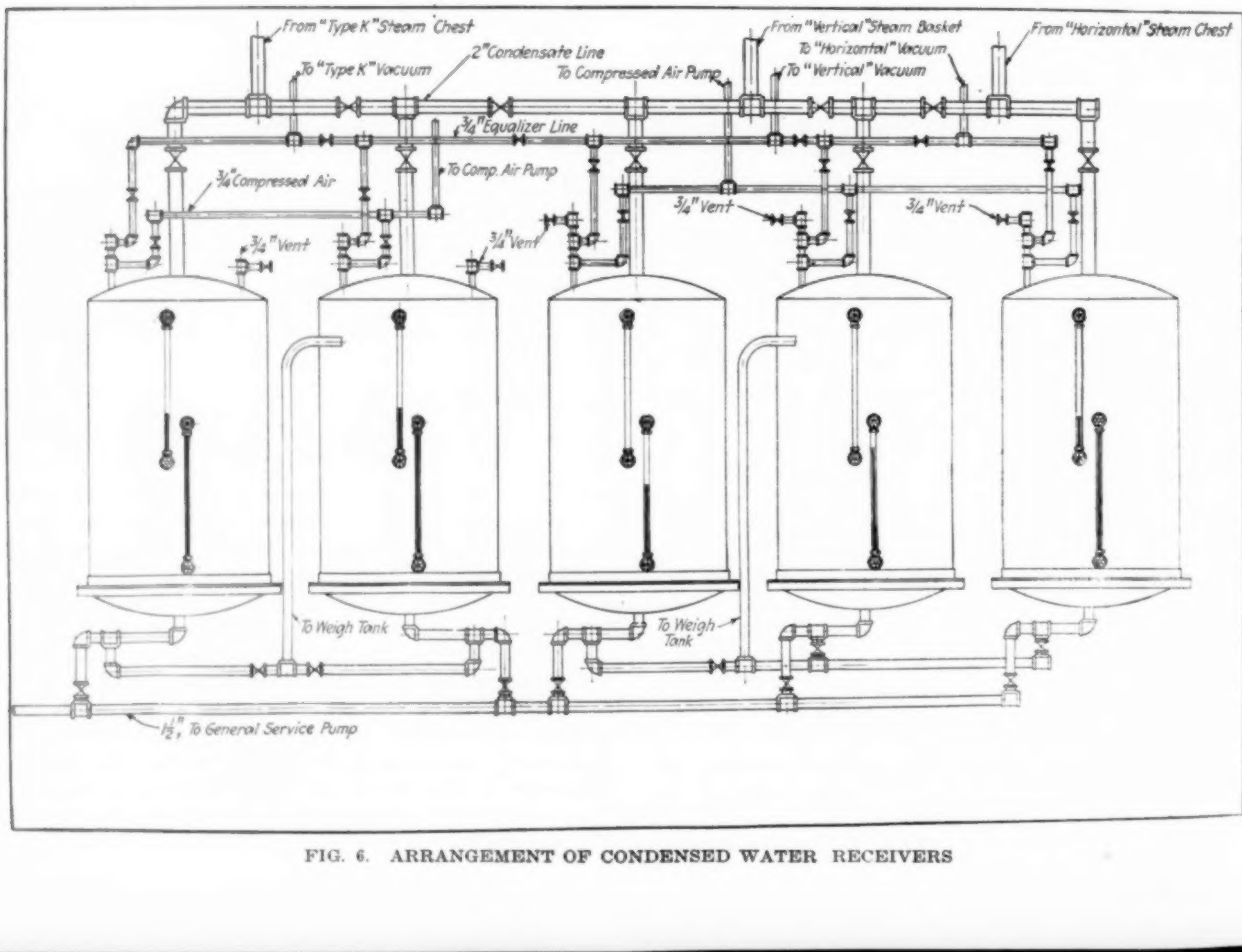


FIG. 6. ARRANGEMENT OF CONDENSED WATER RECEIVERS

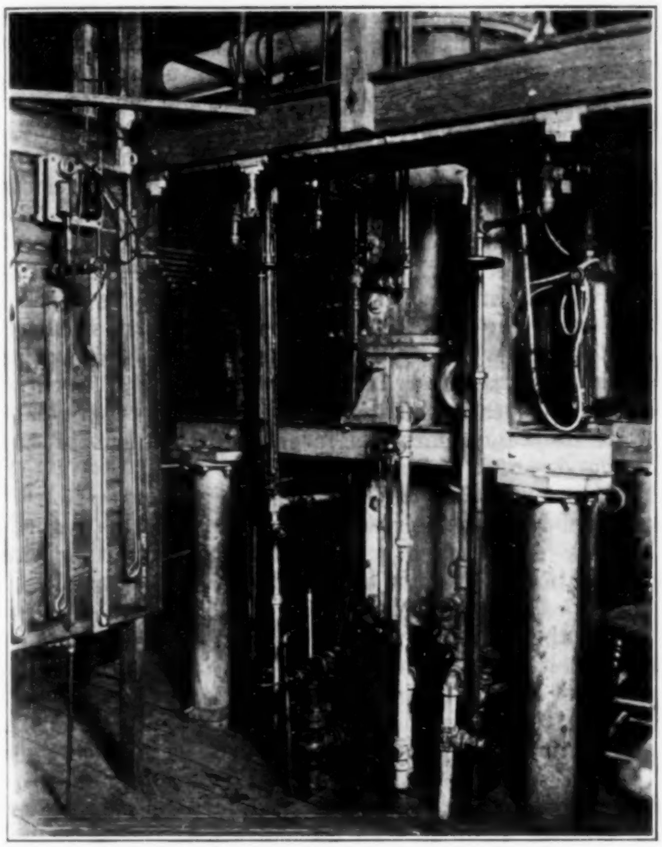


FIG. 7. WORKING PLATFORM; CONTROLS ON VERTICAL TUBE EVAPORATOR

measurement is the weight of steam condensed in a given time.

This is determined by collecting the condensate in receivers (see Fig. 6) in which it may be measured or from which it may be removed and weighed. There are five of these sheet iron tanks 30 in. in diameter, 48 in. high, with heavy cast-iron bottoms and sheet-iron heads. They are all connected into a 2-in. header. Into this header come connections bringing the condensate from the various evaporators. The headers and their valves are so arranged that all the evaporators may run at the same time or more than one receiver may be provided for runs where large amounts of steam are condensed.

In order to vent these receivers and also to remove non-condensed gases, each receiver has a ½-in. vent connected to a ½-in. header. This header in turn has three ½-in. vent lines, each with throttling and blow-off valves, running one to each evaporator. Suitable valves make it possible to vent any receiver to any evaporator. These vents, during a run, are throttled down to the point where they just serve to keep the steam space clear of non-condensed gases.

A header delivers compressed air to each receiver. The bottom outlets have two headers. One delivers to a gooseneck which discharges into a weigh tank, the other leads to the general service pump. Each receiver has carefully calibrated gage glasses and a thermometer for calculating density corrections to the calibrations. During a run the condensate level is noted at the beginning and at the end. The quantity may be calculated from the calibration; or compressed air may be turned in and the condensate blown over into the weigh tank. This latter method, of course, can be used only when the condensate is below 100 deg.

In spite of the large size of the equipment and its complexity, a highly centralized control system has been developed. From the working platform 7.5 ft. above the floor, one man can operate each evaporator and take all necessary readings. Steam, feed, condensate, vent and all other valves may be reached from one position, immediately in front of the manometer board. The condenser and vacuum pump are also controlled from this floor. Fig. 7 shows the controls on the vertical evaporator, and Fig. 8 on the horizontal.

All pressure measurements are made with mercury manometers connected by seamless copper tubing to the point where pressure is to be determined. All manometers for one evaporator are collected on a manometer board near the controls. Temperatures are measured by calibrated thermometers, protected by iron pipe guards. All measurements are taken in the metric system; partly because accurate laboratory apparatus is usually metric, partly because of simplicity of calculation, and partly because practically all of the literature on evaporator design is in German and hence comparisons with previous work are easier if results are in metric units.

Early in the work it was found that maintaining an accurately controlled vacuum was rather difficult. A vacuum regulator was devised which has been very satisfactory (see Fig. 7). A ½-in. pipe is led from the top of the vapor space to the instrument board and carries a Crane needle valve opening to the air. It also carries a special needle valve with no stuffing box around the stem. This stem is prolonged and is connected to a bar of soft iron which forms the core of a solenoid. An iron wire is immersed in the mercury in the open arm of the vacuum manometer. A brass rod ending in a platinum tipped wire passes through a stuffing box into the high side of the vacuum manometer. This rod is threaded and its position may be very accurately adjusted by a milled nut in a small bracket on the instrument board. The vacuum pump is run a little faster than necessary to maintain the desired vacuum. As the mercury in the vacuum manometer rises and reaches the desired point, it makes

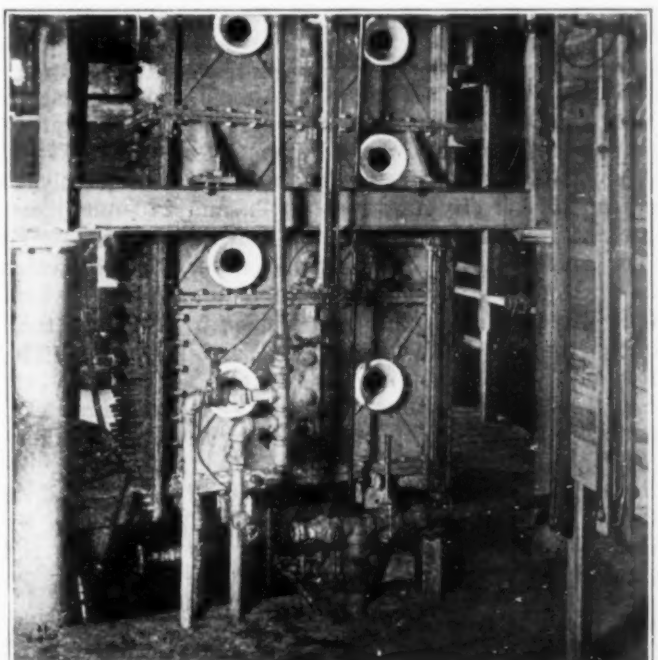


FIG. 8. WORKING PLATFORM; CONTROLS ON HORIZONTAL TUBE EVAPORATOR

contact with the platinum tipped brass rod and thereby closes a circuit through an ordinary telegraph relay. This relay closes a 220-volt circuit through the solenoid, opens the needle valve and bleeds air into the vapor space of the evaporator until the vacuum falls to the desired point. The second needle valve above mentioned is set by hand to give an approximation and the regulator is thus left to take care of only minor fluctuations. The device has worked very satisfactorily and will usually hold the vacuum to within 2 mm. for an indefinite length of time. Occasionally the strokes of the vacuum pump become synchronized with the natural period of vibration of the mercury, which produces regular surges in the manometer with a slight decrease in the accuracy of regulation.

An upper platform, 15 ft. above the floor, is provided for giving access to the upper parts of the evaporators. Weigh tanks and feed tanks, one of each for each evaporator, are located here. When desired, the feed may be weighed, but, as discussed later, this is not often necessary. This obviates maintaining an operator on the upper floor during a test. The station is surrounded by a balcony at this level connecting with these upper platforms and with the office.

General Equipment

The station is served by a 1½-in. class "C" Worthington volute pump. By means of a manifold on the suction and another manifold on the discharge this pump performs practically all the work of the station. One ring discharge main extends around the station connecting with all the storage tanks and evaporator feed tanks. The common suction line is not a complete ring, but includes all the storage tanks on one side and all the evaporators on the other side. There are a number of separate connections besides these two principal mains. A Marsh 3 x 5 x 8 magma pump is connected into the suction line and into the ring main; and valves are so placed that it may be used either as a substitute for the general service pump, or operated in parallel with, but independent of, the general service pump.

The three condensers unite in a cross and the fourth outlet of this cross is connected to an American-Marsh 8 x 10 x 12 vacuum pump. Valves are placed in the lines to the condensers so that evaporators not in use can be completely cut off. This pump and the magma pump mentioned before are a gift to the laboratory from the American Steam Pump Co. of Battle Creek. A small direct steam driven air compressor furnishes air at 25 lb.; city water at 60 lb. and 220-volt direct current are furnished from the university mains. The floor of the station is below the sewer. Waste water is consequently discharged into a sump, from which it is lifted by a Worthington Duplex 5¼ x 4¾ x 5 tank pump, the gift of the Henry R. Worthington Co. The station also has a 10-in. experimental centrifugal (see Fig. 1), loaned by the American Tool & Machine Co., and a No. 2 Sweetland filter, loaned by the United Filters Co. A crystallizer, a steam-jacketed still, and additional transfer pumps will be added in the immediate future. A Tagliabue liquor level regulator loaned by the Tagliabue Manufacturing Co. has simplified the experimental work on the vertical tube evaporator.

Program

The work of the station falls into two very distinct classes. The first, by far the most important, is the class of purely theoretical investigations into the principles of evaporator design. Two papers, the first results of this program, are being presented herewith.[1] These two deal with the vertical tube evaporator because the staff of the station has been insufficient to keep work going continuously on all three evaporators. A great deal has already been done on the horizontal tube evaporator and the "Type K" evaporator, but no results are ready for publication from these machines. The program of problems already outlined involves over sixty separate questions, illustrations of which are the problems already mentioned in connection with the vertical tube and horizontal tube evaporators. It is hoped that it will be possible to publish a continuous series of papers along these lines; and the volume of work so available depends primarily on the growth of graduate work in the chemical engineering department of the University of Michigan.

The second class of work in which the station is engaged is in the solving of concrete problems regarding the development of a particular process or the evaporation of particular solutions. As a sample of the types of problems already handled may be mentioned the following: The production of high-grade table salt from dilute brine carrying much larger amounts of calcium and magnesium chlorides than is considered practical in ordinary salt manufacture; the preparation of a high-grade potash salt from an impure Western brine carrying sulphates, chlorides and carbonates of both potassium and sodium; the evaporation of dextrine sirup to high concentration; the design of a lead evaporator for the manufacture of aluminum sulphate, etc.

The station was originally planned to study evaporators only and consequently no accessory apparatus such as filters, centrifuges, etc., was planned. The size and scope of the concrete problems which have come up have made necessary a revision of this plan, and it is intended now to extend the equipment of the station until there will be in existence a complete chemical plant with all its units on the scale of the evaporators. This will mean that complete processes can be worked through in ton lots. It takes at least 1,000 gal. of a solution to make a satisfactory test so far as the evaporators are concerned. This station is not interested in the working out of new processes on the usual chemical laboratory scale, as there are other organizations much better fitted to handle that class of research work, but we are interested in the working out, on a commercial scale, of processes already established in a chemical laboratory.

Interesting though these specific problems are, it is not intended that they shall ever displace the principal purpose for which the station was founded, which is the study of the underlying principles of evaporator design and through them the extension of our knowledge of the whole phenomenon of heat transmission from steam to liquids.

Chemical Engineering Department,
University of Michigan,
Ann Arbor, Mich.

Cement Factory Opened in Chosen (Korea)

The Onoda Cement Manufacturing Co., of Japan, which was formally opened at Pyongyang, Chosen, in May, is reported to have a capacity of 60,000 tons of cement a year, making it one of the biggest factories of the kind ever established in that country.

[1] These papers will be published in subsequent issues of this Journal.

Current Events
in the Chemical and Metallurgical Industries

Important Sections Planned for Chemical Exposition

The Sixth National Exposition of Chemical Industries, which is to be held at Grand Central Palace, Sept. 20-25, plans many innovations, among which are sections on Fuel Economy, Materials Handling, Chemical Engineering and Industrial Management. Arrangements have been made for the presentation of papers by eminent men in the profession on important topics in these sections according to the following tentative program:

FUEL ECONOMY

Fluid-Heat Transmission .... H. B. McKechnie
Refractory Cement—Life Insurance for a Furnace .... F. W. Reisman
Producer Gas and Modern Mechanical Producer .... W. B. Chapman
Preventing Conduction and Radiation Heat Waste .... S. L. Barnes
Powdered Coal .... W. O. Rankin
American Dressler Tunnel Kilns .... C. Dressler

MATERIALS HANDLING

Chain Belt Transmission .... F. G. Anderson

CHEMICAL ENGINEERING

Nitration .... H. Hough and W. Savage
New Methods of Destructive Distillation .... T. W. Pritchard
Corrosion and Galvanic Action in the Industries .... W. D. Richardson

INDUSTRIAL MANAGEMENT

Ultra Analysis of Costs .... H. E. Ernst
Research in Industrial Conservation .... H. E. Howe

There will be a wide range of exhibits this year. The fact that the Exposition has been divided into sections has caused greater interest than ever and the Materials Handling Division and the Fuel Economy Division, both of which will be new this year, have attracted many large concerns.

As in the past, moving pictures will be a part of the general program. Several new reels depicting various important chemical and mining industries have been arranged for.

The Materials Handling Section will embrace exhibits of machinery and equipment, and will be interesting to manufacturers because every industry must at some stage of its business convey its products from the place of its manufacture to the place of its consumption. Raw material must also be handled, and with the scarcity of man power, machinery promises to be a big factor in the future. It is expected that this section will enable the manufacturers to see the economy as well as the efficiency of machinery in the matter of conveying material.

The Fuel Economy Section is important in view of the high price and the increasing cost of coal. In the section will be shown machinery and apparatus, furnaces, producers, stokers and all devices that tend to the economical utilization and the more efficient combustion of fuel.

With the majority of the exhibits tending along the lines of progress and economy it is evident that a visit to the Exposition will benefit manufacturers and business men. Impressions not to be gained elsewhere which will be valuable in the future will be stowed away, for a glance into the inside of chemistry has been known to bring improved conditions in many industries and manufacturing plants.

Columbia University Offers Six-Year Course in Engineering

To meet the more exacting demands required of men in the engineering profession today, the faculty of Columbia University has arranged a 6-yr. course for would-be engineers. There is a feeling at present among some men that engineers as a whole are not as well educated as other professional men. Columbia, realizing this, is trying to solve the problem by lengthening the engineering courses to six years, three of which will be devoted to general education and three to specialized work.

The first three years are devoted to the study of mathematics, through differential and integral calculus, elementary differential equations, general chemistry and qualitative analysis, general physics, drawing and the humanities. This curriculum, together with the general exchange of ideas through contact between fellow-students from all parts of the civilized world, will give the men greater opportunity to broaden out than is possible in a 4-yr. course.

After the general college course, it is expected that the student will apply all his energies seriously to perfecting himself in the line of endeavor he expects to make his life work, and all the courses are arranged with this end in view, particular emphasis being laid on the further study of subjects pertaining to mining, metallurgical, civil, electrical, mechanical and chemical engineering, and leading to degrees in these professions.

Such an arrangement will not only broaden the men, but will raise the standard of their profession, for by the law of the survival of the fittest the tendency would be for only such men as have the necessary qualifications to stick and complete their course.

Bureau of Mines Seeking Site for Experiment Station

Five cities in the South believe they are especially qualified for the site of the new non-metallic experiment station which is to be established by the Bureau of Mines. They are Chapel Hill, N. C.; Atlanta, Ga.; Birmingham, Ala.; Tuscaloosa, Ala., and Knoxville, Tenn. Dorsey A. Lyon, supervisor of stations for the Bureau of Mines, and Dr. R. B. Moore, its chief chemist, have recently been in the South, checking up the claims of each of the cities mentioned.

In effect, the new station will be a chemical station, since it is the chemical industries that have the greatest interest in non-metals.

Preliminary Program for Chicago Meeting of the American Chemical Society

The Sixtieth Convention of the American Chemical Society to be held with headquarters at the Congress Hotel, Chicago, Sept. 6 to 10, 1920, promises to be a most successful meeting as shown by the plans so far developed by the executive committee of the Chicago Section.

On Monday noon the Chicago Chemists' Club will entertain the directors and officials of the national society at luncheon. The councillors will convene about 4 p.m. on the same day and adjourn at 6:30 to be entertained by the Chicago Section at dinner. This meeting will be re-called at 8 p.m. to continue with the business of the Society.

Tuesday morning the general addresses will start downtown, and after luncheon will be reconvened at the Patten Gymnasium, Northwestern University, Evanston, about 2 p.m. About 4 p.m. the evening entertainment will start. This will be a marked departure from the time-worn smoker, permitting the attendance of the ladies, and consisting of a beach party, picnic supper, athletic contest, college reunions, musical program outdoors, and a special program in the gymnasium after 8 p.m.

Under the towering elms of the campus, on the shores of Lake Michigan, the band concert will continue until 7:30 p.m. Refreshments will be served, and baseball games held between teams to be later announced. The beach of Lake Michigan is a beauty spot which will attract many from the other entertainments during this period. Rowboats will be furnished. The swimming tank in the gymnasium will be open for men. An organ concert will be given in Fisk Hall, from 4:30 to 6 p.m.

A special feature of the outing will be the decoration of the campus with the colors of the American Chemical Society, college banners, chemical fraternity pennants and the colors of other chemical organizations to serve as nuclei and stimulate many reunions. The entertainment committee will provide a booth at which reservations can be made by such groups as desire to sit together at supper. This picnic supper will be served at tables in another portion of the large campus.

The entertainment program, given indoors at 8 p.m., is veiled in mystery as to details. In case of inclement weather all events will be carried out in the mammoth gymnasium, which has several halls large enough to accommodate many times more than will be present.

Other social features provided during the week are entertainments for the ladies and the banquet on Wednesday night. This banquet will be at the Congress Hotel and the program embraces a songfest, timely speeches and numbers by noted opera singers. For the ladies Miss Ethel M. Terry, chairman of the committee, promises an automobile trip, a specially guided tour of the Chicago Art Institute, dinner for the professional women and many alternative excursions. These plans are in addition to the general entertainments which the ladies will attend. There will be a hostess lady for every visiting lady.

Divisional Meetings

While the headquarters of the convention are to be at the Congress Hotel, arrangements have been made to hold all divisional meetings at the University of Chicago. Facilities are there available for lanterns, blackboards and auditoriums with fine acoustic properties such as will make this work a real pleasure. Luncheons are to be provided at the Edelweiss Gardens, a five-minute walk from the buildings. Thursday and Friday will find the visitors then in an atmosphere appropriate to the true purpose of the convention.

Visits to Industrial Plants

On Wednesday afternoon the members will assemble at the Van Buren St. station of the Illinois Central for a visit to the plants of the Sherwin-Williams Paint Co., the Carter White Lead Co., Libby, McNeil & Libby canning plant, the Pullman Car Co. and the Doehler Die Casting Co. Friday morning the works of the Grasselli Chemical Co., the U. S. Lead Refining Co. and the American Maize Products Co. will be inspected, while the afternoon trip will include the Crane Co.'s gray-iron foundry, the Fansteel Co., tungsten products, the Lindsay Light Co. and the Carnotite Reduction Co. plants.

The executive committee of the Chicago Section in charge of the work is composed of the following members: W. Lee Lewis, chairman; F. M. DeBeers, Convention treasurer; R. J. Quinn, Convention secretary; Julius Stieglitz, honorary chairman; W. A. Converse, finance; Chester H. Jones, publicity; H. McCormack, excursions; G. H. Pichard, registration and information; S. L. Redman, hotels; A. E. Schaar, transportation; J. A. Hynes, program; D. K. French, banquet; Herbert N. McCoy, men's entertainment; Ethel M. Terry, ladies' entertainment; William Hoskins, relation to other scientific societies.

Chemical Industries Protest Coal-Tar Priority

While the chemical industries were not represented among those who appeared before the Interstate Commerce Commission to protest against allowing coal mines to have prior claim on open-top cars, the Commission has received many informal complaints from chemical industries, as much of their raw material is moved in that class of equipment. The Commission recognizes that much hardship and great losses are being occasioned by its various orders giving priority to the movement of coal, but feels that it is absolutely necessary to concentrate on coal transportation to the exclusion of most other commodities. This is due largely to the fact that coal can be moved with so much greater facility in the summertime as to constitute a great saving of cars. It is believed that if coal is moved in maximum quantity, up to Sept. 1, the worst of the situation will have been surmounted. After that time, it seems probable, other industries will be able to have their normal proportion of cars.

The decision of the Railroad Labor Board is expected to have a very immediate effect on efficiency in transportation. It is apparent that the Commission is fully determined to stand by its priority orders, despite the great pressure which has been exerted to secure their modification. It was evident that the Commission was most impressed by the complaint that the so-called non-essential industries are being allowed the use of a large portion of the supply of open-top cars which are used in transporting their coal supply, while the chemical industry, the building industries and the maintenance of highways are practically denied any use of this class of railroad cars. The difficulty is that the Commission does not feel that it has the authority to discriminate between essential and non-essential industries.

Industrial Relations Association Elects Officers

J. M. Larkin, assistant to President E. G. Grace of the Bethlehem Steel Co., Bethlehem, Pa., will direct the destinies of the Industrial Relations Association of America for the coming year. He was the unanimous choice of the members of the board of directors at the annual reorganization meeting at Atlantic City. Mr. Larkin is ably qualified for the place, being one of the few industrial relations men of the country who have been given recognition as such by a seat on the board of directors of his company. His handling of the representation plan in effect at the plants of both the Bethlehem Steel Co. and the Bethlehem Shipbuilding Corporation has won him the highest esteem, of both the company and the workers.

Mark M. Jones, director of personnel of the Thomas A. Edison Industries, whose resignation as executive secretary was received and accepted to be effective Sept. 15 at the latest, was elected vice-president. A change in the constitution of the organization is being planned to allow the election of six other vice-presidents, each one of whom will be assigned to a specific territory.

F. C. Parker, executive officer of the Central Y.M.C.A., Chicago, and secretary of Chicago Council, Industrial Relations Association of America, was elected secretary for the second time.

W. H. Winans, of the Union Carbide & Carbon Co., New York City, was elected treasurer. For the present the administrative offices will remain at Orange, with E. A. Shay, the assistant secretary of the association, in charge. A meeting of the board of directors will be held in Buffalo on July 30 to formulate a program for the coming year and to elect a successor to Mr. Jones.

The administrative offices are now engaged in preparing for publication the proceedings of the Chicago convention in May, at which between 2,000 and 3,000 industrial relations workers and executives of all classes were in attendance.

Program of Fall Meeting of T.A.P.P.I.

On Sept. 1 to 3, 1920, the fall meeting of the Technical Association of the Pulp and Paper Industry will take place at Saratoga Springs, N. Y., with headquarters at the Grand Union Hotel. The program gives assurance of a most interesting and instructive meeting.

The business session will open on Wednesday morning, Sept. 1, at 9:30 o'clock, in the Casino. Officers' and committee reports will be presented, followed by papers on special subjects, an especially important one being on the Washing of Felts. In the evening members and guests will be entertained at dinner by the paper manufacturers of the Hudson River Valley and vicinity. The speakers thus far selected include C. R. McMillen, of the Union Bag & Paper Corporation, who will act as toastmaster; Philip T. Dodge, of the International Paper Co., and Colonel C. H. L. Jones, of the Spanish River Pulp & Paper Mills, Ltd.

Thursday, Sept. 2, will be given up to mill visitations, followed by a steamboat excursion on Lake George in the evening. It has been arranged to pay visits of inspection during the day to the plants of the International Paper Co., Finch, Pruyn & Co., Union Bag & Paper Corporation, Standard Wall Paper Co. and Sandy Hill Iron & Brass Works. Automobiles will be provided to convey the members to and from the places visited.

On Friday the members of T.A.P.P.I. and their guests will be taken to the works of the General Electric Co., at Schenectady, where the machinery and electrical apparatus used in pulp and paper mills will be shown in the making. The visitors will subsequently be the guests of the General Electric Co. at luncheon. In the afternoon it is planned to visit the felt mills of F. C. Huyck & Sons and the Albany Felt Co.

T.A.P.P.I. asks the pulp and paper manufacturers who are represented by membership in the association to take a broad and generous view of this gathering of the technical men of the industry and arrange for a good attendance on the part of members connected with their mills, or of prospective members. The stated meetings of T.A.P.P.I. afford valuable opportunities for the discussion of common problems, new developments, methods and processes, and it is hoped that mill executives will appreciate the advantages to be derived from their technical advisers coming in personal contact with the engineers and chemists of other mills in this way.

Chemical Warfare Service and Charcoal

Due to the fact that private concerns at Columbus, Ohio; Elizabeth, N. J., and Cleveland, Ohio, are conducting important researches in connection with the utilization of charcoal for chemical purposes, the Chemical Warfare Service has suspended temporarily that portion of its research work. This is done to avoid possible duplication of effort. Later, the Chemical Warfare Service expects to take up experiments with the synthetic charcoals made from coal and coke.

General A. A. Fries, chief of the Chemical Warfare Service, is gathering many important data regarding special uses of charcoal. Since the efficiency of the gas mask depends upon certain classes of charcoal, the Chemical Warfare Service expects to keep in very close touch with all developments in that connection. Just at present, General Fries is greatly interested in the development of an excellent charcoal from rice husks. The rice husk contains a great deal of silica and as a result, when properly burned, does not powder into a lampblack. During the war it was found that the charcoal made from coconut shell was best suited for use in gas masks. Cohune nut charcoal and peach pit charcoal came next in respective desirability. As yet no better substitutes have been found, but experiments are planned which will take up the matter of impregnating charcoals with chemicals which will add to their efficiency in neutralizing gases.

General Fries will request an appropriation at the next session of Congress which will enable him to add several civilian chemists of ability to his staff. At present the chemists needed in the service must be drawn from the Army. It is the desire of General Fries to supplement his staff of military chemists with several civilian chemists who have specialized in the subjects of greatest interest to the Chemical Warfare Service. This need will be met in the meantime by the appointment of consulting chemists who will be willing to give a limited amount of time to the problems of the Service, in connection with their regular work. They will be paid a nominal salary. The first consulting chemist to be appointed is Dr. E. E. Reed, of Johns Hopkins. Other appointments will be made soon.

Quebec Pulpwood Embargo to Stay

It is announced officially that the Quebec Government has no intention of raising the embargo on the export of pulpwood as has been demanded by American interests.

Bakelite Used for Airplane Propellers

A series of tests with Bakelite propellers has recently been completed by the Army Air Service. The results are reported to have been satisfactory. Several designs of propellers were used, but the micarta construction was more serviceable. These propellers were made by coating sheets of duck with Bakelite, then pressing five or six of these sheets tightly together to form a board that is sawed out in the shape of a propeller lamination just as wood laminations are cut. The Bakelite is then molded to an exact angle in a special mold under pressure at 350 deg. F.

The advantages discovered in the Army tests are: Uniformity of texture; strength; absence of warping; elasticity; absence of metal hub; uniformity of all propellers made from the same mold; proof against abrasion; proof against moisture, including oil; freedom from checking and splitting; adjustable pitch feature, resulting partly from elasticity; ease and rapidity of manufacture, once the molds are completed.

Shortage of Chlorine Affects Purification of Water Supply

Complaints of short supplies of chlorine and other chemicals used in water purification have reached the Interstate Commerce Commission from several sources. It is the opinion of Dr. R. B. Moore, chief chemist of the Bureau of Mines, that these shortages are chargeable mainly to the transportation situation, but he calls attention to a general tendency on the part of chemical manufacturers to overestimate the length of time that stocks accumulated during the war will last. The fact that stocks frequently are overestimated and that consumption is greater than is realized has resulted in great scarcity in several chemicals. Stocks become low before the manufacturing of new supplies starts, with the result that shortages become acute before production catches up with demand.

Retirement of Government Scientists

The only member of the scientific staff of the U. S. Geological Survey who will retire at an early date under the recent act for retirement of Government employees is T. Nelson Dale, geologist. Mr. Dale has been for a long period on the geological staff of the Survey, engaged particularly in economic geology studies of slate, granite, marble, etc.

Dr. F. W. Clarke, chief chemist, and William H. Dall, geologist and paleontologist, are of retirement age, but under the provisions of the act will be retained in active service for an additional period.

None of the members of the scientific staff of the Bureau of Mines is affected by the provisions of this act for retirement. Similiarly none of the scientific men at the Bureau of Standards will be retired.

Shortage of Motor Fuel Serious

The gasoline shortage in the Pacific Northwest is rapidly becoming acute. For the past month it has been with difficulty that the three large oil companies operating in that territory have been able to provide sufficient gasoline for the most necessary of occupations. The rationing system has been in effect for a month and in general has limited trucks to purchases of ten gallons and pleasure cars to tankfuls of three gallons. Only vehicles operated by fire and police departments and doctors have been able to secure unlimited supplies. The Standard Oil Co., Shell Co. and Union Oil Co. do not offer any hope for permanent relief from the shortage until in the middle of the summer at the very earliest with possibilities that strict economy will be necessary until next fall. The reasons ascribed to the shortage, are insufficiency of supply of the oil obtainable in California oil fields. Besides affecting hundreds by shortage of the gasoline supply, the lack of fuel oil is also embarrassing a great many manufacturers in that since they are equipped to burn fuel oil, it is with difficulty that they are able to rapidly make changes that will provide for coal burning. It is possible that the ultimate solution for this latter situation may be the substitution of powdered coal or producer gas.

Chemical Exports and Imports During May

Exports of chemicals during May, 1920, were valued at $18,357,237. This is nearly double the value of the chemicals exported in May, 1919. Some of the items making up the total, as well as revised figures for May, 1919, are as follows:

	May, 1919	May, 1920
	Lb.	Lb.
Acids:		
Carbolic	130,457	420,274
Nitric	17,890	99,359
Picric	88	53
Sulphuric	1,627,860	2,655,432
Benzol	70,482	1,484,630
Calcium carbide	2,883,309	1,452,955
Copper sulphate	861,168	461,916
Lime:		
Acetate of	97,017	4,425,267
Chloride of (bleaching powder)	1,752,352	5,560,938
Chlorate of potash	57,380	235,130
	Value	Value
Total sodas	$927,600	$2,702,473
Total chemicals	9,733,513	18,357,237
Total dyes and dyestuffs	954,943	3,377,885
Medicinal and pharmaceutical preparations	1,523,784	2,305,718

Some of the import figures, as compiled by the Bureau of Foreign and Domestic Commerce, are as follows:

Acids (except coal tar acids):	Lb.	Lb.
Oxalic (duty)	none	6,406
All others:		
Duty	266,791	490,926
Free	4,260,288	1,096,921
Chemical and medicinal compounds:		
Alkalis, alkaloids and preparations, mixtures of (duty)	418,731	777,661
Medicinal preparations (duty)	84,473	150,293
	Value	Value
Total coal-tar products	$737,909	$634,840
Total gums	2,520,845	5,714,192
Total chemicals, drugs, dyes, etc.:		
Free	4,534,508	15,734,604
Duty	6,229,522	5,286,458

Re-exported chemicals, as compiled by the Bureau of Foreign and Domestic Commerce, are:

	1919	1920
	Lb.	Lb.
Acids:		
Carbolic	none	none
Oxalic	none	11,540
All other	7,204	74,415
Extracts and decoctions for tanning:		
Quebracho	21,442	566,419
All other	none	971,196
Gums:		
Camphor, crude, natural	264	13,431
Camphor, refined and synthetic	2,625	19,448
Copal, dammar and kauri	98,677	160,719
Gambrier, or terra japonica	none	16,503
Indigo, natural or synthetic	14,014	74,455
Iodine, crude or resublimed	none	none
Licorice root	372	none
Opium, containing 9 per cent and over of morphia	789	41,538
Carbonate of potash	none	none
Nitrate of soda	none	none
	Value	Value
Total chemicals, re-exported	$222 443	$1,052,878

Movement to Form Chemical Warfare Service Association

A movement is under way to establish a Chemical Warfare Service Association. Qualifications for membership will not be restrictive and anyone who is particularly interested in the work being performed by the Service will be eligible.

More Swiss Dyes Here

Another large consignment of Swiss dyes, consisting of 13 casks, 4 barrels, 115 packages, 90 cylinders and 5 cases, arrived the first week in July from Havre. It is understood that these assorted colors will be disposed of in the same way as former consignments, without disturbance to the local market. Further shipments from the same source are expected and arrangements have already been made for allotments to the consuming trade.

It is not expected that these foreign products will interfere in the slightest degree with the market for American colors; in fact there is a tendency to welcome the relief thus afforded from the pressure brought to bear on the manufacturers.

Railroad conditions are still retarding business, but the most serious handicap thus far experienced has been the shortage of coal at plants. This has already resulted in the shutting down of one New Jersey plant and curtailment of operations at others.

Additions to Columbia University Metallurgical Laboratory

In addition to the equipment of the Columbia University metallurgical department, in the ore-dressing laboratory, which was installed by Prof. H. S. Munroe, now retired, there is being added, under the direction of Prof. Arthur F. Taggert, a Hardinge conical mill, a Dorr classifier, a Dorr thickener, a Deister-Overstrom concentrating table with interchangeable decks, flotation equipment to demonstrate different successful flotation processes, and considerable accessory equipment such as microscopes, polariscopes, refractometers and viscosimeters. Additional motors are also being provided to drive this machinery. These changes and additions have been made possible by the generosity of machinery manufacturers and of individuals and mining companies who have contributed money.

Executive Committee Meeting of the Manufacturing Chemists Association

The regular monthly meeting of the executive committee of the Manufacturing Chemists Association was held at the India House, New York City, Wednesday, July 21. The session was called to order by Chairman Henry Howard of the Grasselli Chemical Co. The committee voted favorably on the mechant marine bill and expressed hope that it would help the export business. The Chamber of Commerce referendum No. 31 was also favorably received.

In co-operation with the Bureau of Explosives the test committee is working out standard tests for carboys to reduce the percentage of breakage in transportation. This work is being carried on at the Grasselli Chemical Co.'s plant in New Jersey.

Rubber From Candleweed

The plant of the Ocotillo Products Co. at Salome, Ariz., has started operations and is producing a ton of crude rubber per day from the ocotillo, or candleweed, which grows wild in great abundance in that section. The product is said to vulcanize satisfactorily and to act in every way like rubber. One ton of ocotillo yields 200 lb. of gum and 90 lb. of a tarry product which is marketable.

The company was organized in Indianapolis, Ind., but will establish permanent offices in Los Angeles.

Bureau of Mines to Assist in Power Survey

O. P. Hood, chief mechanical engineer of the Bureau of Mines, will be a member of the principal engineering staff in connection with the superpower investigations of the U. S. Geological Survey. Mr. Hood presumably will be directly in charge of those aspects of this power development work which relate to coking of coal and efficiency in fuel utilization. He will be responsible for tieing up the Survey superpower study with the related investigations of the Bureau of Mines, most of which are under his direction. This development is directly in line with the editorial comment made in this journal recently, referring to the possibility of coking coal and augmenting the supply of byproduct gas in lieu of developing electric power and building transmission lines. It indicates that the problems emphasized as important from an industrial-chemical point of view will receive that attention which they deserve, as Mr. Hood is intimately acquainted with these.

Book Reviews

ELECTRIC FURNACES IN THE IRON AND STEEL INDUSTRY. By *W. Rodenhauser*, *J. Schoenwa* and *C. H. Vom Baur*. Third edition, 1920. New York: John Wiley & Sons; London: Chapman & Hall, Ltd.

Electric Furnaces in the Iron and Steel Industry contains considerably more information descriptive of electric iron and steel furnaces and more electrometallurgy of iron and steel than any other book which has been published on the subject. The book is written in a somewhat German style, and contains considerable descriptive matter which the average technical reader might not consider necessary. The arrangement of the book would be improved if the information in the two chapters of Part II—materials used in furnace construction, and the electrometallurgy of iron and steel—was placed where the subjects are first discussed in Part I. This is especially true of the electrometallurgy of iron and steel, as a reader familiar with the subject finds considerable data lacking when he reads the discussion on electric furnace pig iron in Part I. Too much space has been allotted to the induction furnace. The induction steel furnace may have considerable standing in Germany, but it has none in the United States, where interest in it is largely of a historical nature. An excellent feature is the inclusion of basic electrical information on which the design and operation of electric furnaces is dependent. Considering the fact that Heroult electric steel furnaces have been installed in considerably greater number than any other type of electric steel furnace, not enough space is devoted to this furnace. The value of the book would be increased by discussion of processes to a greater length, including manufacture of steel castings, alloy steel, acid steel and basic steel, and giving more actual operating detail for use of the furnace operator. A new development covered briefly is the production of synthetic pig iron from steel turnings in Canada. It is to be regretted that the book went to press a little too early to include the results of Keller on production of synthetic foundry iron. An important subject not mentioned is the heat treatment of steel in the electric resistance furnace, a phase of electrometallurgy which has had a great development during the past three years.

Except for the following additions there are few changes in the text from that of the 3rd edition, 1917: Seede electrode regulator, Greene furnace, Moore furnace, Booth-Hall furnace, Vom Baur furnace, Ludlum furnace, pig iron from steel turnings, and duplexing with the cupola. Although the arrangement of the book is not the best, and there are several important omissions, the book contains a large quantity of information and is the most up-to-date publication on the subject. ROBERT M. KEENEY.

Personal

Dr. CHARLES FREDERICK CHANDLER received the honorary degree of Doctor of Science at the recent commencement exercises at Union College. In conferring the degree, Dr. Charles Alexander Richmond, chancellor of the university, spoke briefly as follows: "Charles Frederick Chandler, educated at Lawrence Scientific School, Harvard University, and at the Universities of Berlin and Göttingen; professor of chemistry at Union College, 1857-1864; one of the organizers and for many years dean of the School of Mines of Columbia University; author of many chemical papers; member of many scientific and learned societies both here and abroad; the recipient of distinguished academic honors from universities in America and England; esteemed by your profession, beloved by generations of grateful students to whom you have imparted both knowledge and wisdom, we delight also to do you honor. *Honoris causa*, I admit you to the degree of Doctor of Science and direct that your name be enrolled among the honorary sons of Union College."

M. J. GAVIN, refinery engineer for the U. S. Bureau of Mines, with headquarters at Salt Lake City, visited the San Francisco office of the Bureau during June, in connection with oil-shale development.

DAVID JONES, who holds an 1851 exhibition scholarship (from London University) at Johns Hopkins University, is now connected with the chemical division of the Eastman Kodak Co.'s research laboratory.

Dr. R. B. MOORE, chief chemist of the Bureau of Mines, and DORSEY A. LYON, its supervisor of experiment stations, have returned from an inspection visit to the various points in the South which are under consideration as sites for the new non-metallic mineral station. It is expected that the selection will be announced within a week.

JAMES T. NEWTON, Commissioner of Patents, has tendered his resignation to the President, which was effective July 19. No official report that the President had accepted has been received, but it is understood that he will. Commissioner Newton expressed great reluctance at leaving the office after thirty years' Government service, and mentioned the inadequate salary of $5,000 a year among his reasons for resigning.

Dr. HARRISON E. PATTEN has recently resigned as research chemist of the Bureau of Chemistry, Department of Agriculture, to accept an appointment as chief chemist of the phosphate plant of the Provident Chemical Works, St. Louis, Mo.

A. B. PORTMAN has recently been appointed assistant sales manager of acids and heavy chemicals for the Monsanto Chemical Works at St. Louis, Mo., vice John W. Carroll, who has been transferred to higher duties.

F. L. RIGHTER, a Leland Stanford University graduate, who during the past year has been doing graduate work in the chemistry department at Cornell University, has joined the staff of the research laboratory of the Eastman Kodak Co., Rochester, N. Y.

L. D. VORCE has severed his connection with the Canadian Salt Co. to take an active part in the business of the Precision Instrument Co., Newark, N. J.

Obituary

FRED S. BRADLEY, son of Peter B. Bradley, president of the American Agricultural Chemical Co., died on July 5. Mr. Bradley was manager of the Jacksonville, Fla., branch of the company. His death was the result of the collapse of the wheel of the automobile he was driving on the beach at Jacksonville.

Current Market Reports

The Iron and Steel Market

Pittsburgh, July 23, 1920.

The iron and steel market has become still more inactive, conditions bordering almost on stagnation. There is some buying, but it is only of material that the buyer is assured he will need in the very near future, or is in the nature of covering requirements in the distant future with the Steel Corporation. In other words, buying of steel products is for very late delivery, the first or second quarter of next year in the case of the Steel Corporation, and is only for very early delivery in the case of the independents. The difference in policy is of course due to the difference in prices quoted. In the matter of pig iron, there are occasional instances reported in other districts of small purchases for late delivery, but in general the buying of pig iron is only for very early shipment, and usually by consumers who are already covered by contract but are not getting deliveries.

TRANSPORTATION CONDITIONS

The common testimony is that transportation conditions, as regards the supply of cars for loading at blast furnaces and steel mills, have grown worse in the past week. An exception is the Chicago district, where, it is said, a little of the accumulated steel has been moved. In the steel industry as a whole the stocks of steel at mill are not only increasing, but are increasing at a more rapid rate than a month ago.

The further curtailment in car supplies is attributed to service order No. 7 of the Interstate Commerce Commission, giving preference in car supplies to coal mines. The original order was dated June 21, and it has since been renewed for an additional thirty days, or to Aug. 19. Last week there was some expectation of relief to the furnaces and mills by an interpretation issued, that the order is not to include, as coal cars, flat bottom gondola cars under 36 in. high, inside measurement. Previously most of the roads had been considering as coal cars any such cars over 30 in. in height. As an offset to the results of the new interpretation, however, has come strict enforcement of the point that coal cars may be loaded only in the direction of the coal. It seems there had been considerable evasion, or loose interpretation, of this point, but with the strict interpretation very few cars indeed will come under the permission.

The chief hope of the iron and steel trade in the matter of car supplies now is that the coal mines will soon be well enough supplied with cars that there will be a surplus for other uses. It is recognized that it will not be necessary to furnish the coal mines with 100 per cent of their theoretical requirements, for it is reasonably clear that with a considerably smaller supply than that one of these so-called "labor shortages" will develop, whereby additional cars could not be used. The shortage would not be in the number of men, but in the time put in, the experience of the river mines showing that the men are not willing to work day after day the full eight hours.

CURTAILMENTS

Thus far there has been practically no curtailment of steel production by reason of inability to ship, although of course there has been curtailment on account of fuel, chiefly coke, not being in abundance. Since the first of the month there has been more or less curtailment of finishing operations, by mills leaving more steel in semi-finished form. If, however, definite relief from present shipping conditions does not come within thirty days, or possibly sixty days at the very outside, it will be necessary for steel production itself to be curtailed. Possibly it would have been prudent to begin curtailing steel production before this. The finishing departments can stand only a

moderate overload, and to accumulate large quantities of unfinished or semi-finished steel would mean that the finishing departments would require a very long time to work off the surplus, providing of course they had to take care of current steel production at the same time.

The further difficulty is now becoming rather pressing, that finished steel rolled to customers' specifications may prove quite unacceptable months hence, it being clear that with the greatest improvement in transportation that can be hoped for it will be a long time before the last of the mill accumulations disappears. Accordingly many of the mills are now following a new policy in shipping, and are using such cars as are available for moving material that is particularly special in character, as for instance from being cut to length, and the mills are taking such material either from stock or from current rolling, as occasion presents itself. The object is to leave the mill, to such an extent as is possible, only with stock sizes on hand.

Construction Work Light

For several weeks past the mills have reported demand for plates and structural shapes as particularly light, this being quite in contrast with demand for merchant bars of the smaller sizes, this demand being quite heavy.

Prices for steel products for prompt shipment show further weakening in spots, although for sheets there seems to be a somewhat stiffer market. Prices of the large independents, for moderately early but rather uncertain delivery, are at the level that has ruled for several months, while the Steel Corporation prices are of course unchanged. Independent prices may all recede to the Steel Corporation level, though this is far from certain, but no one seems to think that the Steel Corporation level can possibly be endangered even should there be a continuance of this dull market for several months.

The Chemical and Allied Industrial Markets Today and a Year Ago

New York, July 23, 1920.

Inasmuch as the quiet that has become almost customary in the chemical market still persists, this week's article will compare prices with those of a year ago, instead of repeating the commonplace "news" of the last few months. Among the heavy chemicals there are only two items of current interest: (1) sulphate of aluminum, and (2) citric and tartaric acids. Ordinarily, *sulphate of aluminum* (iron free) sells for 3@4c. per lb. in car lots; but small stocks and the almost impossibility of obtaining bauxite has boosted the price to 6c. The commercial sulphate has advanced to 4¾c., as against a former price of 1½@3c. As for *citric* and *tartaric acids*, the sharp drops are the outcome of too many speculators in sugar. Tartaric has declined from 80@85c. to 70@72c.; citric from 80@100c. to 78c.

In the *coal tars* it is interesting to note that one concern sold 19,000 lb. of *paranitraniline* in a single day last week, whereas there had not been a sale made in the two weeks preceding. *Beta naphthol* (technical) sells for 80@95c., against 45@55c. a year ago, owing to increased demand and smaller production because of shortage of raw materials. Improved methods of manufacture have lowered the price of *phthalicanhydride* from $1.75@$2.15 to 60@70c. per lb. Coal-tar products that are active at the present time are shown in the following table in comparison with prices a week ago and a year ago.

	Current	Week Ago	Year Ago
Aniline oils, drums extra	$0.33 @ $0.34	$0.34¾ @ $0.36	$0.25 $0.30
Aniline salts	0.40 @ 0.42	0.41 @ 0.45	0.28 0.33
Beta naphthol, tech	0.80 @ 0.95	0.80 @ 0.88	0.45 0.55
Metaphenylenediamine	1.25 @ 1.30	1.23 @ 1.30	1.20 1.80
Paranitraniline	1.30 @ 1.40	1.40 @ 1.50	1.00 1.25
Paraphenylenediamine	2.50 @ 2.65	2.50 @ 2.75	2.75 4.00
Phthalicanhydride	0.60 @ 0.70	0.65 @ 0.75	1.75 2.15

In the ensuing tabulations for waxes, rosins, rubber and fish oil, it will be found that prices are generally lower than a year ago.

WAXES

Original quantities in large packages, per lb.

	Current	Week Ago	Year Ago
Carnauba, No. 3, North Country	$0.35 @ $0.36	$0.36 @ $0.37	$0.60 @ $0.75
Stearic acid, single pressed	0.24 @ 0.25	0.25 @ 0.26	0.25 @ 0.27
Stearic acid, double pressed	0.25 @ 0.26	0.26 @ 0.27	0.28 @ 0.29

NAVAL STORES

Carload Lots

	Current	Week Ago	Year Ago
Rosin E-I, 280 lb.	$16.60 @ $16.75	$16.10 @ $16.25	$17.50 @ $18.75
Rosin K-N, 280 lb.	17.00 @ 17.20	16.25 @ 16.35	21.00 @ 22.25
Rosin W-G @ W-W, 280 lb.	17.25 @ 17.50	16.50 @ 16.70	22.50 @ 22.75
Rosin oil, first run	0.70	0.67	0.81 @ 0.91
Rosin oil, second run, gal	0.73	0.70	0.83 @ 0.93
Rosin oil, third run, gal	0.92	0.87	0.88 @ 1.10

CRUDE RUBBER

Per Pound

	Current	Week Ago	Year Ago
Para—Upriver fine	$0.32 @ $0.33	$0.34¼ @ $0.35	$0.54 @ $0.55½
Upriver coarse	0.23 @ 0.24	0.24 @ 0.24½	0.31 @ 0.33
Upriver caucho ball	0.23 @ 0.24	0.26 @ 0.26½	0.31 @ 0.34
Plantation—			
First latex crepe	0.32½	0.32½ @ 0.33	0.39½ @ 0.40½
Ribbed smoked sheets	0.31½	0.33 @ 0.33½	0.38½ @ 0.39½
Brown crepe, thin, clean	0.30	0.32 @ 0.32½	0.34½ @ 0.35½
Amber crepe, No. 1	0.30	.... @ 0.35	0.36½ @ 0.37

MENHADEN OILS

Per Gallon

	Current	Week Ago	Year Ago
Winter pressed	$0.90 @ $1.05	$1.17 @ $1.18	$1.25 @ $1.35
Yellow bleached	0.95 @ 1.05	1.20 @ 1.22	1.27 @ 1.37
White bleached	1.00 @ 1.25	1.23 @ 1.24	1.29 @ 1.38
Blown	1.00 @ 1.20	1.30 @ 1.32	1.35 @ 1.40

The Chicago Market

Chicago, Ill., July 21, 1920.

With apathetic demand, scarcity of spot stocks and producers sold up for some time to come in the general chemical line, with the vegetable oil market absolutely dead and with transactions in naval stores still hampered by lack of shipping facilities, there is little of interest to report from the Chicago district. The exhaustion of spot stocks of general chemical lines has tended to eliminate the second-hand dealer and the speculator, and the fact that factories have their entire output under contract for some time to come will prevent the re-entry of that element into the market in the near future.

Heavy Chemicals

In the face of reports of a weaker market in the East the *alkalis* have held their own locally, as supply is extremely limited. *Caustic soda*, both solid and granulated, is firm at 6@6½c. per lb., with handlers of spots turning away more business than they are accepting. Contracts are quoted around 5½c. *Soda ash*, as scarce as ever, is nominally quoted at $3.50 per cwt. and at least one transaction involving fifty drums was carried through last week at $3.75 per cwt. *Sal soda*, when obtainable, commands $1.90 per cwt. for delivery from stock and no futures are offered lower than $1.70. Demand is materially in excess of available supply. Nominal quotations on bleaching powder range from 6c. to 7c. per lb. with but few actual transactions reported.

Stiff prices rule on *arsenic*, oxide lumps (white) being held firmly at 16½@17½c. per lb., depending on quantity. The powdered sulphide (red) is quoted at around 20c., with no undue pressure of demand. *Barium chloride* continues to advance, nominal quotation on imported being $185 to $190 per ton. But few transactions are recorded and they probably passed at figures slightly lower than quotations. *Carbon tetrachloride* shows little change, spots going for 11½@12c. per lb. Producers maintain this price is too low and offer contracts no lower than 13c. *Sodium sulphate crystals* (Glauber's salts) are at a premium for spots, $2.75 per cwt. being the prevailing price. Futures are offered at about a dollar lower.

Nothing can be added to the last report in regard to *alcohol*. Both *ethyl* and *methyl* are available in quantities much less than normal demand and are finding a ready sale at the prevailing high prices. *Denatured*, under extraordinary demand, is up to $1.10 a gal. Buying of *formaldehyde* seems restricted by high prices, and a reduction of 2c. in the prevailing price, to 53c. a lb., has failed to arouse any great interest. *Glycerine*, c.p., at 29c., remains in slack demand.

Acid business remains quiet, consumers being content to proceed on a hand-to-mouth basis. Offers of spot stocks at seemingly attractive prices find no active demand. Producers are rapidly catching up in deliveries on contract and spot supplies are ample. *Acetic*, 28 per cent commercial, is quoted at \$3.87½ per cwt. on contract. Holders of stocks of *carbolic* are finding but small demand at the offered price of 12c. per lb. *Muriatic* (hydrochloric) is not available in as great quantity as the others and but little is changing hands at \$3@\$3.15 per cwt. A wide range in offerings and slight demand are noted in *nitric*, 42 deg. being quoted at 7½@8c. per lb. *Sulphuric acid* is available for prompt delivery at \$23 per ton for 66 deg. in tanks.

Vegetable Oils

Development of the fact that practically unlimited supplies of flaxseed are in sight has brought *linseed oil* down to the lowest point for some time, with but little interest shown by either buyer or seller. Quotations for immediate delivery, f.o.b. Chicago, are: for tank car lots, \$1.52 per gal.; for car lots in cooperage, \$1.59, and for barrels in less than car lots, \$1.62. Contracts for future delivery are offered at 11c. less than above figures, but with the expectation of still lower figures, business is light. For *cottonseed oil* the demand is so slight as to be negligible. Prime summer yellow is offered at 12½c. and refined, deodorized, at 19c., f.o.b. Chicago. *Coconut oil* is likewise dull at 12½c. per lb. in sellers' tanks, f.o.b. Coast. Spots from local stock go at 15½@16c. Current shipments of *soya bean oil*, in sellers' tanks, f.o.b. Coast, are offered at 10¾c., with next month's delivery quoted at ½c. less. Little interest is shown in any of these offerings.

Naval Stores

Supplies are being received much more freely now, several cars of *turpentine* having arrived during the last few days. Demand is sufficient to absorb receipts and to maintain a price of \$1.75 per gal. on barrels in carload lots, 5c. less in drums. Requirements of *pine oil* are still in excess of supply and the price is firm at \$1.90 per gal. on both pure and destructively distilled. The shortage in the items was so great during the spring that it will take considerable time to get supply back to normal. Receipts of *rosin* are approaching normal, \$15.80@\$15.90 being today's ruling quotation on E, F and G grades.

The St. Louis Market

St. Louis, Mo., July 19, 1920.

The St. Louis chemical market continues quiet and prices for the most part are firm. Many of the larger buyers are contracting for their present needs only and manufacturers are loath to take on large contracts for future delivery on account of the present labor conditions and the raw material situation. The transportation situation continues to show improvement, although car movements continue to be slow. The supply of most chemicals is now ample to meet present demands and little change in prices is to be expected in the near future.

The demand for *sulphuric acid* continues good and prices show a small increase. The 60 deg. grade is quoted at \$15 per ton, an advance of \$1 per ton over two weeks ago. The 66 deg. is quoted at \$24 per ton, as against \$22 per ton two weeks ago. *Oleum* remains unchanged at \$27.50 per ton. Prices are based on carload lots.

The market for *muriatic acid* is quiet and prices are unchanged at \$25 per ton in carload lots and 2@2.25c. per lb. in carboys for the 18 deg. grade. The recent shortage of *sodium bisulphate* has been relieved. Price remains unchanged at \$6 per ton in carload lots.

Nitric acid is unchanged and quoted in carload lots at \$7 per cwt. for 36 deg., \$8 for 38 deg., \$9 for the 40 deg. and \$10 for the 42 deg. Standard *mixed acid* consisting of 36 deg. nitric and 61 deg. sulphuric acid is quoted at 11.5c. per lb. per degree of nitric and 1.5c. per lb. per degree of sulphuric acid. *Zinc chloride*, of 50 per cent solution, is unchanged at \$3.50 to \$3.75 per cwt. The supply of *phenol* is plentiful and prices are unchanged at 12c. per lb. in lots of fifteen tons or more.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

		Carlots	Less Carlots
Acetic anhydride	lb.	–	\$0.65 – \$0.75
Acetone	lb.	\$0.15 – \$0.20	.21 – .22
Acid, acetic, 28 per cent	cwt.	3.50 – 3.75	4.00 – 4.50
Acetic, 56 per cent	cwt.	6.50 – 7.50	8.50 – 9.50
Acetic, glacial, 99½ per cent. carboy	cwt.	16.20 –	16.25 –
Boric, crystals	lb.	.15 – .15½	.16 – .19
Boric, powder	lb.	.15 – .15½	.16 – .20
Citric	lb.	.78 –	.82 –
Hydrochloric (nominal)	cwt.	2.00 – 3.00	3.10 – 4.00
Hydrofluoric, 52 per cent	lb.	.13½ – .14	.14½ – .15½
Lactic, 44 per cent tech	lb.	.11 – .11½	.12 – .16
Lactic, 22 per cent tech	lb.	.04½ – .05½	.06 – .07
Molybdic, C. P.	lb.	4.00 – 4.50	4.50 – 5.00
Muriatic, 20 deg. (see hydrochloric)		–	–
Nitric, 40 deg	lb.	.06 – .07	.07½ – .08½
Nitric, 42 deg	lb.	.07½ – .08	.08½ – .09¼
Oxalic, crystals	lb.	.55 – .57	.60 – .65
Phosphoric, Ortho, 50 per cent solution	lb.	.14 – .23	.24 – .25
Picric	lb.	.28 – .35	.40 – .50
Pyrogallic, resublimed	lb.	2.25 – 2.55	2.60 – 2.65
Sulphuric, 60 deg., tank cars	ton	14.00 – 16.00	–
Sulphuric, 60 deg., drums	ton	–	–
Sulphuric, 66 deg., tank cars	ton	16.00 – 17.00	18.00 – 20.00
Sulphuric, 66 deg., drums	ton	26.00 – 28.00	–
Sulphuric, 66 deg., carboys	ton	–	–
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	27.00 – 30.00	37.00 – 42.00
Sulphuric, fuming, 20 per cent (oleum) drums	ton	28.00 – 30.00	38.00 – 42.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	32.00 – 35.00	40.00 –
Tannic, U. S. P.	lb.	1.45 – 1.50	1.55 – 1.60
Tannic (tech.)	lb.	.60 – .70	.80 – .90
Tartaric, crystals	lb.	–	.70 – .72
Tungstic, per lb. of WO	lb.	–	1.20 – 1.40
Alcohol, Ethyl (nominal)	gal.	5.10 – 5.50	6.00 – 7.00
Alcohol, Methyl, 95%	gal.	–	3.25 – 3.30
Alcohol, Methyl, pure	gal.	–	3.50 – 3.55
Alcohol, denatured, 188 proof (nominal)	gal.	–	1.10 – 1.15
Alcohol, denatured, 190 proof (nominal)	gal.	–	1.05 – 1.10
Alum, ammonia lump	lb.	.04½ – .05	.05½ – .06
Alum, potash lump	lb.	.07½ – .08¼	.09 – .09½
Alum, chrome lump	lb.	.15½ – .18	.19 – .20
Aluminum sulphate, commercial	lb.	.04¼ –	–
Aluminum sulphate, iron free	lb.	.06 –	–
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.09¼ – .10¼	.11 – .12
Ammonia, anhydrous, cylinders (100-150 lb.)	lb.	.32 – .35	.35 – .40
Ammonium carbonate, powder	lb.	.16 – .16½	.17 – .18
Ammonium chloride, granular (white salammoniac) (nominal)	lb.	.16 – .16½	.17 – .18
Ammonium chloride, granular (gray salammoniac)	lb.	.12½ – .13½	.13½ – .14¼
Ammonium nitrate	lb.	.09 – .10	.11 – .14
Ammonium sulphate	lb.	.07 – .07¼	.08½ –
Amylacetate	gal.	–	5.00 –
Amylacetate tech.	gal.	–	4.75 – 5.25
Arsenic, oxide, lumps (white arsenic)	lb.	.15½ – .16	.16½ – .17
Arsenic, sulphide, powdered (red arsenic)	lb.	.20 – .21	.22 – .23
Barium chloride	ton	150.00 – 160.00	–
Barium dioxide (peroxide)	lb.	.21 – .23	.24 – .25
Barium nitrate	lb.	.09½ – .11	.11 – .12
Barium sulphate (precip.) (blanc fixe)	lb.	.04½ – .05	.05½ – .06
Bleaching powder (see calcium hypochlorite)		–	–
Blue vitriol (see copper sulphate)		–	–
Borax (see sodium borate)		–	–
Brimstone (see sulphur, roll)		–	–
Bromine	lb.	.70 – .90	1.00 – 1.05
Calcium acetate	cwt.	3.50 – 3.55	–
Calcium carbide	lb.	.04½ .04½	.04¾ – .05½
Calcium chloride, fused, lump	ton	25.00 – 30.00	35.00 – 45.00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02½
Calcium hypochlorite (bleaching powder)	cwt.	–	4.50 – 6.50
Calcium peroxide	lb.	–	1.50 – 1.70
Calcium phosphate, monobasic	lb.	–	.75 – .80
Calcium sulphate, pure	lb.	–	.25 – .30
Carbon bisulphide	lb.	.08 – .09	.10 – .11
Carbon tetrachloride, drums	lb.	.14 – .15	.16 – .17
Carbonyl chloride (phosgene)	lb.	–	.80 – 1.05
Caustic potash (see potassium hydroxide)		–	–
Caustic soda (see sodium hydroxide)		–	–
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.09 – .09½	.10 – .10½
Chloroform	lb.	.30 – .35	.36 – .38
Cobalt oxide	lb.	–	2.00 – 2.05
Copperas (see iron sulphate)		–	–
Copper carbonate, green precipitate	lb.	.27 – .28	.29 – .31
Copper cyanide	lb.	–	.65 – .70
Copper sulphate, crystals	lb.	.08 – .09	.09 – .09¼
Cream of tartar (see potassium bitartrate)		–	–
Epsom salt (see magnesium sulphate)		–	–
Ethyl Acetate Com. 85%	gal.	1.35 –	1.40 –
Ethy Acetate pure (acetic ether 98% to 100%)		–	1.75 –
Formaldehyde, 40 per cent (nominal)	lb.	–	57 – 65
Fusel oil, ref	gal.	–	5.25 – 6.00
Fusel oil, crude (nominal)	gal.	–	–
Glauber's salt (see sodium sulphate)		–	–
Glycerine	lb.	–	.26½ – .28½
Iodine, resublimed	lb.	4.30 – 4.35	4.40 – 4.45
Iron oxide, red	lb.	–	03 – 20
Iron sulphate (copperas)	cwt.	–	2.75 – 3.50
Lead acetate, normal	lb.	–	.13½ – .16
Lead arsenate (paste)	lb.	.11 – .12	.13 – .17
Lead nitrate, crystals	lb.	–	90 – 1.00
Litharge	lb.	.14 – .15	.15½ – .16
Lithium carbonate	lb.	–	1.50 –
Magnesium carbonate, technical	lb.	.12 – .14	.15 – .16
Magnesium sulphate, U. S. P.	100 lb.	3.00 – 3.55	4.00 – 4.50
Magnesium sulphate, commercial	100 lb.	–	3.25 – 3.60
Nickel salt, double	lb.	–	.14 – .16
Nickel salt, single	lb.	–	.13 – .14
Phosgene (see carbonyl chloride)		–	–
Phosphorus, red	lb.	.50 – .55	.60 – .65
Phosphorus, yellow	lb.	–	.35 – .37
Potassium bichromate	lb.	.50 – .55	.57 – .60

		Carlots	Less Carlots
Potassium bitartrate (cream of Tartar)	lb.	$0.52 – $0.56	$0.57 – $0.58
Potassium bromide, granular	lb.	..... –	.90 – .95
Potassium carbonate, U. S. P.	lb.	..... –	.47 – .50
Potassium carbonate, crude	lb.	.20 – .25	.26 – .28
Potassium chlorate, crystals	lb.	.15 – .17	.18 – .20
Potassium hydroxide (caustic potash)	lb.	.30 – .33	.35 – .38
Potassium iodide	lb.	..... –	3.35 – 3.60
Potassium nitrate	lb.	.15 – .17	.19 – .21
Potassium permanganate	lb.	.75 – .80	.85 – .95
Potassium prussiate, red	lb.	.90 – 1.00	1.05 – .....
Potassium prussiate, yellow	lb.	.32 – .36	.35 – .40
Potassium sulphate (powdered)	ton	$225.00 – 240.00	..... – .....
Rochelle salts (see sodium potas. tartrate)		..... –	..... – .....
Salammoniac (see ammonium chloride)		..... –	..... – .....
Sal soda (see sodium carbonate)		..... –	..... – .....
Salt cake	ton	..... –	40.00 – 50.00
Silver cyanide (nominal)	oz.	..... –	1.25 – .....
Silver nitrate (nominal)	oz.	..... –	.63 – .70
Soda ash, light	100 lb.	..... –	3.50 – 3.60
Soda ash, dense	100 lb.	..... –	3.55 – 3.65
Sodium acetate	lb.	.08½ – .09	.09½ – .12
Sodium bicarbonate	100 lb.	2.60 – 2.75	3.00 – 3.50
Sodium bichromate	lb.	.24 – .27½	.28 – .29
Sodium bisulphate (nitre cake)	ton	7.00 – 7.50	8.00 – 10.00
Sodium bisulphite Powered, U.S.P.	lb.	.08½ –	.09 – .....
Sodium borate (borax)	lb.	.09 – .10	.11 – .12
Sodium carbonate (sal soda)	100 lb.	1.50 – 1.80	1.80 – 2.00
Sodium chlorate	lb.	.11 – .12	.12½ – .13
Sodium cyanide, 96-98 per cent	lb.	.25 – .30	.32 – .35
Sodium fluoride	lb.	.18 –	.19 – .20
Sodium hydroxide (caustic soda)	100 lb.	..... –	6.50 – 7.50
Sodium hyposulphite	lb.	..... –	.03 – .04
Sodium molybdate	lb.	2.50 –	3.25½ – .....
Sodium nitrate	100 lb.	3.00 – 3.25	3.75 – 4.00
Sodium nitrite	lb.	.16 – .18	.19 – .20
Sodium peroxide, powdered	lb.	.32 – .35	.35 – .40
Sodium phosphate, dibasic	lb.	.03½ – .04½	.04½ – .05
Sodium potassium tartrate (Rochelle salts)	lb.	..... –	.39 – .40
Sodium prussiate, yellow	lb.	.23 – .27	.31 – .32
Sodium silicate, solution (40 deg.)	lb.	.01½ – .01¾	.02 – .02¼
Sodium silicate, solution (60 deg.)	lb.	.02¼ – .03	.04 – .05
Sodium sulphate, crystals (Glauber's salt)	cwt.	1.60 – 1.70	1.75 – 2.50
Sodiumsulphide, crystal, 60–62 per cent (conc)	lb.	.09½ – .10	.10½ – .11
Sodium sulphite, crystals	lb.	.04 –	.05 – .07
Strontium nitrate, powdered	lb.	.17½ – .18½	.19 – .20
Sulphur chloride red	lb.	.08 – .09	.10 – .10½
Sulphur, crude	ton	25.00 – 30.00	..... – .....
Sulphur dioxide, liquid, cylinders	lb.	.09 –	.10 – .12
Sulphur (sublimed), flour	100 lb.	..... –	3.80 – 4.35
Sulphur, roll (brimstone)	100 lb.	..... –	3.40 – 3.90
Tin bichloride (stannous)	lb.	.42½ – .44	.45 – .46
Tin oxide	lb.	..... –	..... – .....
Zinc carbonate, precipitate	lb.	.16 – .18	.19 – .20
Zinc chloride, gran.	lb.	.13 – .13½	.13½ – .17
Zinc cyanide	lb.	.45 – .49	.50 – .60
Zinc dust	lb.	.11 – .12	.12 – .13
Zinc oxide, U. S. P.	lb.	.17 – .25	..... – .....
Zinc sulphate	lb.	.03¼ – .03½	.04 – .06

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha naphthol, crude	lb.	$1.40	— $1.50
Alpha naphthol, refined	lb.	1.60	— 1.70
Alpha naphthylamine	lb.	.53	— .55
Aniline oil, drums extra	lb.	.33	— .34
Aniline salts	lb.	.40	— .42
Anthracine, 80% in drums (100 lb.)	lb.	.90	— 1.00
Benzaldehyde (f.f.c.)	lb.	2.00	— 2.10
Benzidine, base	lb.	1.35	— 1.40
Benzidine, sulphate	lb.	1.15	— 1.25
Benzoic acid, U.S.P.	lb.	.95	— 1.00
Benzoate of soda, U.S.P.	lb.	.80	— .90
Benzol, pure, water-white, in drums (100 lb.)	gal.	.35	— .40
Benzol, 90%, in drums (100 lb.)	gal.	.33	— .38
Benzyl chloride, 95-97%, refined	lb.	.33	— .40
Benzyl chloride, tech	lb.	.25	— .35
Beta naphthol benzoate (nominal)	lb.	3.50	— 4.00
Beta naphthol, sublimed (nominal)	lb.	.....	— .....
Beta naphthol, tech (nominal)	lb.	.85	— .95
Beta naphthylamine, sublimed	lb.	2.25	— 2.40
Cresol, U. S. P., in drums (100 lb.)	lb.	.18	— .19
Ortho-cresol, in drums (100 lb.)	lb.	.23	— .25
Cresylic acid, 97-99%, straw color, in drums	gal.	1.05	— 1.15
Cresylic acid, 95-97%, dark, in drums	gal.	1.00	— 1.05
Cresylic acid, 50%, first quality, drums	gal.	.65	— .75
Dichlorbenzol	lb.	.08	— .10
Diethylaniline	lb.	1.50	— 1.60
Dimethylaniline	lb.	1.35	— 1.45
Dinitrobenzol	lb.	.30	— .37
Dinitroclorbenzol	lb.	.32	— .35
Dinitronaphthaline	lb.	.45	— .55
Dinitrophenol	lb.	.40	— .45
Dinitrotoluol	lb.	.40	— .45
Dip oil, 25%, tar acids, car lots, in drums	gal.	.38	— .40
Diphenylamine (nominal)	lb.	.80	— .85
H-acid (nominal)	lb.	2.25	— 2.50
Metaphenylenediamine	lb.	1.25	— 1.30
Monochlorbenzol	lb.	.18	— .20
Monoethylaniline	lb.	2.00	— 2.40
Naphthaline crushed, in bbls. (250 lb.)	lb.	.....	— .....
Naphthaline, flake	lb.	.....	— .19
Naphthaline, balls	lb.	.....	— .19
Naphthionic acid, crude	lb.	.75	— .85
Nitrobenzol	lb.	.14	— .15
Nitro-naphthaline	lb.	.40	— .50
Nitro-toluol	lb.	.18	— .25
Ortho-amidophenol	lb.	3.25	— 4.25
Ortho-dichlor-benzol	lb.	.15	— .20
Ortho-nitro-phenol	lb.	.80	— 1.25
Ortho-nitro-toluol	lb.	.25	— .40
Ortho-toluidine	lb.	.35	— .45
Para-amidophenol, base	lb.	2.50	— 3.00
Para-amidophenol, HCl	lb.	2.50	— 3.00
Para-dichlor-benzol	lb.	.08	— .12
Paranitraniline	lb.	1.30	— 1.40
Para-nitro-toluol	lb.	$01.35	— $01.50
Paraphenylenediamine	lb.	2.50	— 2.65
Paratoluidine	lb.	2.00	— 2.50
Phthalic anhydride	lb.	.60	— .70
Phenol, U. S. P., drums (dest.), (240 lb.)	lb.	.12	— .20
Pyridin	gal.	2.00	— 3.50
Resorcin, technical	lb.	4.25	— 4.50
Resorcin, pure	lb.	6.25	— 6.75
Salicylic acid, tech., in bbls. (110 lb.)	lb.	.50	— .52
Salicylic acid, U. S. P.	lb.	.50	— .60
Salol	lb.	.90	— 1.00
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.33½	— .35½
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.23	— .26
Sulphanilic acid, crude	lb.	.32	— .35
Toluidine	lb.	1.70	— 2.50
Toluidine, mixed	lb.	.45	— .55
Toluol, in tank cars	gal.	.35	— .....
Toluol, in drums	gal.	.38½	— .40½
Xylidine, drums, 100 gal.	lb.	.50	— .65
Xylol, pure, in drums	gal.	.37	— .45
Xylol, pure, in tank cars	gal.	.35	— .....
Xylol, commercial, in drums, 100 gal.	gal.	.37	— .45
Xylol, commercial, in tank cars	gal.	.23	— .27

Waxes

Prices based on original packages in large quantities.

Beeswax, refined, dark	lb.	$0.36	— $0.39
Beeswax, refined, light	lb.	.39	— .40
Beeswax, white pure	lb.	.63	— .68
Carnauba, No. 1 (nominal)	lb.	1.00	— 1.05
Carnauba, No. 2, regular (nominal)	lb.	.85	— .88
Carnauba, No. 3, North Country	lb.	.35	— .36
Japan	lb.	.19	— .19½
Montan, crude	lb.	.23	— .25
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.09	— .09½
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.10	— .10¼
Paraffine waxes, refined, 118-120 m.p.	lb.	.11½	— .12
Paraffine waxes, refined, 125 m.p.	lb.	.12¼	— .....
Paraffine waxes, refined, 128-130 m.p.	lb.	.14½	— .15¼
Paraffine waxes, refined, 133-135 m.p.	lb.	.16½	— .17
Paraffine waxes, refined, 135-137 m.p.	lb.	.17½	— .18½
Stearic acid, single pressed	lb.	.24	— .25
Stearic acid, double pressed	lb.	.25	— .26
Stearic acid, triple pressed	lb.	.27	— .28

NOTE—Paraffine waxes very scarce.

Flotation Oils

All prices are f.o.b. New York, unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Pine oil, steam dist., sp. gr., 0.930-0.940	gal.	$2.30
Pine oil, pure, dest. dist.	gal.	1.80
Pine tar oil, ref., sp. gr. 1.025-1.035	gal.	.48
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.	.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.	.85
Pine tar, ref., thin, sp. gr., 1.080-1.960	gal.	.36
Turpentine, crude, sp. gr., 0.900-0.970	gal.	2.00
Hardwood oil, f.o.b. Mich., sp. gr., 0.960-0.990	gal.	.35
Pinewood creosote, ref.	gal.	.52

Naval Stores

The following prices are f.o.b., New York, for carload lots.

Rosin B-D, bbl.	280 lb.	$12.25	—$16.25
Rosin E-I	280 lb.	16.60	— 16.75
Rosin K-N	280 lb.	17.00	— 17.20
Rosin W. G.-W. W.	280 lb.	17.25	— 17.50
Wood rosin, bbl.	280 lb.	15.00	— .....
Spirits of turpentine	gal.	1.58	— .....
Wood turpentine, steam dist.	gal.	.....	— .....
Wood turpentine, dest. dist.	gal.	.....	— .....
Pine tar pitch, bbl.	200 lb.	.....	— 8.50
Tar, kiln burned, bbl. (500 lb.)	bbl.	14.50	— 15.00
Retort tar, bbl.	500 lb.	15.00	— 15.50
Rosin oil, first run	gal.	.70	— .....
Rosin oil, second run	gal.	.73	— .....
Rosin oil, third run	gal.	.92	— .....

Solvents

73-76 deg., steel bbls. (85 lb.)	gal.	$0.40
70-72 deg., steel bbls. (85 lb.)	gal.	.38
68-70 deg., steel bbls. (85 lb.)	gal.	.37
V. M. and P. naphtha, steel bbls. (85 lb.)	gal.	.29

Crude Rubber

Para—Upriver fine	lb.	$0.32	— $0.33
Upriver coarse	lb.	.23	— .24
Upriver caucho ball	lb.	.23	— .24
Plantation—First latex crepe	lb.	.32½	— .....
Ribbed smoked sheets	lb.	.31½	— .....
Brown crepe, thin, clean	lb.	.30	— .....
Amber crepe No. 1	lb.	.30	— .....

Oils

VEGETABLE

The following prices are f.o.b., New York for carload lots.

Castor oil, No. 3, in bbls.	lb.	$0.17	— $0.18
Castor oil, AA, in bbls.	lb.	.19	— .....
China wood oil, in bbls.	lb.	.18½	— .19
Cocoanut oil, Ceylon grade, in bbls.	lb.	.16	— .....
Cocoanut oil, Cochin grade, in bbls (nominal)	lb.	.17¼	— .17½
Corn oil, crude, in bbls.	lb.	.16	— .16½
Cottonseed oil, crude (f.o.b. mill)	lb.	.10	— .11
Cottonseed oil, summer yellow	lb.	.13¼	— .13½
Coteonseed oil, winter yellow	lb.	.19	— .....
Linseed oil, raw, car lots (domestic)	gal.	1.20	— .....
Linseed oil, raw, tank cars (domestic)	gal.	1.30	— .....
Linseed oil, boiled, car lots (domestic)	gal.	1.35	— .....

Olive oil, commercial	gal.	3.00	—	3.10
Palm, Lagos	lb.	.10½	—	....
Palm, bright red	lb.	.10½	—	....
Palm, Niger	lb.	.11	—	.12
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.12½	—	.12½
Peanut oil, refined, in bbls	lb.	.17	—	.18
Rapeseed oil, refined in bbls	gal.	1.65	—	....
Rapeseed oil, blown, in bbls	gal.	1.70	—	....
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.14	—	.14½
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.10½	—	.11

FISH

Winter pressed Menhaden	gal.	$0.90	—	$1.05
Yellow bleached Menhaden	gal.	0.95	—	1.05
White bleached Menhaden	gal.	1.00	—	1.25
Blown Menhaden	gal.	1.00	—	1.20

Miscellaneous Materials

All f. o. b. New York Unless Otherwise Stated

Barytes, ground, white, f.o.b. Kings Creek, S. C.	net ton	$22.00	—	$25.00
Barytes, ground, off color, f.o.b. Kings Creek	net ton	18.00	—	20.00
Barytes, crude, 88%@94% ba., Kings Creek	net ton	8.00	—	10.00
Barytes, ground, white, f.o.b. Cartersville, Ga.	net ton	23.00	—	25.00
Barytes, ground, off-color, f.o.b. Cartersville	net ton	16.00	—	19.00
Barytes, crude, 88%@94% ba., Cartersville	net ton	12.00	—	....
Barytes, floated, f.o.b. St. Louis	net ton	25.50	—	28.00
Barytes, crude, min. 98% ba., Missouri	net ton	11.00	—	11.25
Blanc fixe, dry	lb.	.05½	—	.06
Blanc fixe, pulp	net ton	60.00	—	80.00½
Casein	lb.	.15	—	.18
Chalk, domestic, extra light	lb.	.05	—	.06
Chalk, domestic, light	lb.	.04½	—	.05½
Chalk, domestic, heavy	lb.	.04	—	.05
Chalk, English, extra light	lb.	.05	—	.07
Chalk, English, light	lb.	.05	—	.06
Chalk, English, dense	lb.	.04½	—	.05
China clay, (Kaolin) crude, f.o.b. mines, Georgia	net ton	9.00	—	12.00
China clay (Kaolin) washed, f.o.b. Georgia	net ton	12.00	—	15.00
China clay (Kaolin) powdered, f.o.b. Georgia	net ton	18.00	—	22.00
China clay (Kaolin) crude f.o.b. Virginia points	net ton	8.00	—	12.00
China clay (Kaolin) ground, f.o.b. Virginia points	net ton	15.00	—	40.00
China clay (Kaolin), imported, lump	net ton	25.00	—	35.00
China clay (Kaolin), imported, powdered	net ton	30.00	—	60.00
Feldspar, crude, f.o.b. Maryland and North Carolina points	gross ton	7.50	—	8.00
Feldspar, crude, f.o.b. Maine	net ton	7.50	—	10.00
Feldspar, ground, f.o.b. Maine	net ton	21.00	—	23.00
Feldspar, ground, f.o.b. North Carolina	net ton	17.00	—	20.00
Feldspar, ground, f.o.b. N. Y. State	net ton	17.00	—	20.00
Fuller's earth, granular, f.o.b. Fla.	net ton	25.00	—	....
Fuller's earth, powdered, f.o.b. Fla.	net ton	18.00	—	....
Fuller's earth, imported, powdered	net ton	35.00	—	40.00
Graphite (dust polish grade 30%) Ashland, Ala.	lb.	......	—	.01
Graphite (dust facing grade 50%) Ashland, Ala.	lb.	......	—	.02
Graphite, crucible, 80% carbon Ashland, Ala.	lb.	......	—	.05
Graphite, crucible, 90% carbon Ashland, Ala.	lb.	......	—	.10
Graphite, crucible, 85% carbon	lb.	......	—	.08
Graphite, crucible, 88% carbon	lb.	......	—	.09½
Graphite, crucible, 90% carbon	lb.	......	—	.10½
Pumice stone, imported, lump	lb.	.04	—	.50
Pumice stone, domestic, lump	lb.	.06	—	....
Pumice stone, ground	lb.	.04	—	.07
Quartz (acid tower) fist to head, f.o.b. Baltimore	net ton	......	—	10.00
Quartz (acid tower) 1½@2 in., f.o.b. Baltimore	net ton	......	—	14.00
Quartz (acid tower) rice, f.o.b. Baltimore	net ton	......	—	17.00
Quartz, lump, f.o.b. North Carolina	net ton	5.00	—	7.50
Shellac, orange fine	lb.	1.35	—	....
Shellac, orange superfine	lb.	1.45	—	....
Shellac, A. C. garnet	lb.	1.05	—	1.15
Shellac, T. N.	lb.	1.20	—	1.30
Soapstone	ton	1[illegible].00	—	25.00
Talc, paper-making grades, f.o.b. Vermont	ton	9.50	—	14.00
Talc, roofing grades, f.o.b. Vermont	ton	8.00	—	9.00
Talc, rubber grades, f.o.b. Vermont	ton	9.00	—	15.00
Talc, powdered, Southern, f.o.b. cars	ton	12.00	—	15.00
Talc, imported	ton	60.00	—	70.00
Talc, California Talcum Powder grade	ton	20.00	—	35.00

Refractories

Chrome brick, f.o.b. Chester, Pa., carlots	net ton	90- 100
Chrome brick, 9-in. strs. and sizes, f.o.b. Baltimore	net ton	80- 90
Fire clay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	45- 53
Fire clay brick, 1st quality, f.o.b. St. Louis	1,000	45- ...
Fire clay brick, 1st quality, f.o.b. New Jersey	1,000	75- ...
Fire clay brick, 2d quality, 9-in. shapes f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	40- ...
Magnesite brick, 9 in. straights, f.o.b. Baltimore	net ton	90
Magnesite brick, 9-in. sizes and shapes larger than 9-in.		Regular extras
Magnesite brick, f.o.b. Chester	net ton	90- 100
Silica brick, 9-in. and 9-in. sizes, Chicago district	1,000	55- ...
Silica brick, f.o.b. Birmingham	1,000	51- 55
Silica brick, f.o.b. Mt. Union, Pa.	1,000	50- 55

Ferro-Alloys

All f.o.b. Works

Ferro-carbon-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00	—	$250.000
Ferro-chrome, per lb. of Cr. contained, 6-8% carbon, carlots	lb.	.17	—	.18
Ferro-chrome, per lb. of Cr. contained, 4-6% carbon, carlots	lb.	.19	—	20
Ferro-manganese, 76-80% Mn.	gross ton	190.00	—	225.00
Spiegeleisen, 18-22% Mn.	gross ton	75.00	—	.....
Ferro-molybdenum, 50-60% Mo, per lb. of Mo.	lb.	2.50	—	3.00
Ferro-silicon, 10-15%	gross ton	60.00	—	65.00
Ferro-silicon, 50%	gross ton	80.00	—	90.00
Ferro-silicon, 75%	gross ton	150.00	—	160.00
Ferro-tungsten, 70-80%, per lb. of contained W.	lb.	1.10	—	1.15
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	7.00	—	.....
Ferro-vanadium, 30-40% per lb. of contained V.	lb.	6.50	—	7.75

Ores and Semi-finished Products

All f.o.b. Mines, Unless Otherwise Stated

Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	unit	.60		.65
Chrome ore, 40%, min., Cr_2O_3 f.o.b. Atlantic Seaboard	unit	.77	—	.85
*Coke, foundry, f.o.b. ovens	net ton	18.00	—	19.00
*Coke, furnace, f.o.b. ovens	net ton	17.50	—	18.50
*Coke, petroleum, refinery, Atlantic Seaboard	net ton	24.00		
Fluor spar, lump, f.o.b. Tonuco, New Mexico	net ton	17.50	—	.....
Fluor spar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	...	—	25.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.02	—	.....
Manganese Ore, 50% Mn, c.i.f. Atlantic seaport	unit	.72½	—	.75
Manganese ore, chemical (MnO_2)	gross ton	75.00	—	85.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.60	—	.65
Monazite, per unit of ThO_2	unit	42.00	—	.....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.12	—	.....
Pyrites, Spanish, furnace size, c.i.f., Atlantic seaport	unit	.16½	—	.....
Pyrites, Spanish, run of mines, c.i.f., Atlantic seaport	unit	.12	—	.14
Pyrites, domestic, fines	unit	.12	—	.14
Rutile, 95% TiO_2 per lb. ore	lb.	.15	—	.....
Tungsten, Scheelite, 60% WO_3 and over, per unit of WO_3	unit	7.00	—	.....
Tungsten, Wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C.	unit	6.50	—	7.50
Uranium Ore (Carnotite) per lb. of U_3O_8	lb.	2.75	—	3.00
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.75	—	3.00
Vanadium pentoxide, 99%	lb.	12.00	—	14.00
Vanadium Ore, per lb. of V_2O_5 contained	lb.	1.25	—	.....
Zircon, washed, iron free	lb.	.10	—	.....

*Nominal

Non-Ferrous Metals

New York Markets

	Cents per Lb.
Copper, electrolytic	19.00
Aluminum, 98 to 99 per cent	33.00
Antimony, wholesale lots, Chinese and Japanese	8.00
Nickel, ordinary	43.00
Nickel, electrolytic	45.00
Tin, Straits, spot	49.50
Lead, New York, spot	9.25
Lead, E. St. Louis, spot	8.90
Zinc, spot, New York	8.25@8.75
Zinc, spot, E. St. Louis	7.90@8.40

OTHER METALS

Silver	oz.	$0.99½
Cadmium	lb.	1.40@1.50
Bismuth (500 lb. lots)	lb.	2.70
Cobalt	lb.	2.50@3.00
Magnesium (f.o.b. Niagara Falls)	lb.	1.75
Platinum	oz.	80@85
Iridium	oz.	350.00
Palladium	oz.	80.00
Mercury	75 lb.	90.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	33.50
Copper bottoms	38.00
Copper rods	38.00@40.00
High brass wire and sheets	30.25
High brass rods	25.00
Low brass wire and sheets	28.50
Low brass rods	29.00
Brazed brass tubing	43.25
Brazed bronze tubing	41.75
Seamless copper tubing	34.00
Seamless high brass tubing	33.00

SCRAP METALS

	Cents per Lb. Buying Price
Aluminum, cast scrap	23.00@23.50
Aluminum, sheet scrap	23.00@23.50
Copper, heavy machinery comp.	14.50@15.00
Copper, heavy and wire	14.75@15.25
Copper, light and bottoms	13.75@14.25
Copper, heavy cut and crucible	15.50@16.00
Brass, heavy	9.50@10.00
Brass, light	7.25@7.75
No. 1 clean brass turnings	9.00@9.50
No. 1 comp. turnings	12.50@13.50
Lead, tea	4.75@5.00
Lead, heavy	7.25@7.50
Zinc, scrap	5.00@5.50

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.47	$3.97	$3.47	$5.00	$3.37	$3.97	$3.47
Soft steel bars	4.62	4.12	3.37	4.50	3.27	3.87	3.37
Soft steel bar shapes	4.62	4.12	3.37	....	3.27	3.87	3.37
Soft steel bands	6.32	5.32	4.07	6.25	....	....	....
Plates, ¼ to 1 in. thick	4.68	4.17	3.67	4.50	3.57	4.17	3.67

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

California

CLAREMONT—Pomona College is having plans prepared for the construction of a 2-story, 60x200-ft. chemical laboratory. Estimated cost, $200,000. James P. Jameson, Security Bldg., St. Louis, Mo., archt. and engr.

Connecticut

BRIDGEPORT — The Amer. Tube & Stamping Co., 471 Hancock Ave., will build a 1-story, 55x60-ft. manufacturing plant on Stratford Ave. Estimated cost, $14,000. Work will be done by day labor.

BRISTOL—The City School Comn. will receive bids until Aug. 3 for the construction of a 3-story high school at Dunbar Meadows. A chemical laboratory will be installed in same. Estimated cost, from $750,000 to $800,000. Wilson Potter, 22 East 17th St., New York City, archt.

NEW HAVEN—The Fritzell Brass Fdry. Co., 33 Chestnut St., will soon award the contract for the construction of a 1-story, 60x150-ft. factory. Estimated cost, $40,000. Fletcher Thompson Inc., 1089 Broad St., archt. and engr. Noted May 19.

NEW HAVEN—The Natl. Folding Box & Paper Co., James St., plans to build additions to plant.

NEW HAVEN—The New Haven Pulp & Board Co. has awarded the contract for altering a factory to Levering & Garriques, 552 West 23d St., New York City. Estimated cost, $30,000.

ROCKVILLE—The J. J. Regan Mfg. Co., 74 West Main St., has awarded the contract for the construction of a 1-story, 21x70-ft. addition to finishing plant and a 1-story, 40x80-ft. dye house to J. H. Grozier Co., 721 Main St., Hartford. Estimated cost, $16,000.

STAMFORD — The Petroleum Heat & Power Co., Selleck St., has awarded the contract for the construction of a 1-story foundry to H. Wales Lines Co., 134 State St., Meriden. Estimated cost, $15,000.

WATERBURY — The Waterbury Farrel Fdry. & Machine Co., 425 Bank St., will build a 1-story, 45x180-ft. factory addition. Estimated cost, $45,000. Work will be done by day labor.

District of Columbia

WASHINGTON—The General Purchasing Officer of the Panama Canal will receive bids until Aug. 2 for furnishing 3,200 lb. of bone black, hydrocarbonated, in barrels of approximately 400 lb. each, to be manufactured from selected hard white bone, charred, ground to a uniform mseh and then charged with additional carbon extracted from a hydrocarbon oil; 100,000 lb. of calcium carbide, 1¼x⅜ in, commercially pure; and 5,000 lb. of asbestos magnesia furnace cement.

Illinois

CHICAGO — The Abbott Laboratories, 4753 Ravenswood Ave., will build a chemical manufacturing plant, including ten 1-story buildings, at 4800 Ravenswood Ave. Estimated cost, $225,000. Work will be done by day labor.

CHICAGO—The Amer. Car & Foundry Co., 2417 Paulina St., has purchased a site along Paulina St., near Blue Island Ave., and plans to build a plant on same. Estimated cost, $2,000,000.

CHICAGO—A. Finkel & Sons Co., 1326 Cortland St., had plans prepared for the construction of a 1-story, 32x98-ft heat treating plant. Estimated cost, $20,000. E. M. Newman, 80 West Washington St., archt.

Indiana

CROWN POINT — The Bd. of County Comrs. had plans prepared for the construction of a 2-story, 100x200-ft. hospital here. Chemical laboratory equipment will be installed in same. Estimated cost, $400,000. J. N. Coleman, Chicago, Ill., archt.

EAST CHICAGO — The Carroll Castings Co. has purchased a site on the Indiana Harbor Belt R.R., Gibson St., and plans to construct a plant for the manufacture of small gray iron castings on same. Equipment will be installed in same.

INDIANAPOLIS — The General Amer. Tank Car Corp., Euclid Ave. and 145th St., East Chicago, plans to build a large addition to its brass foundry and is in the market for equipment for same.

INDIANAPOLIS — The Pioneer Brass Wks., 424 South Pennsylvania St., has awarded the contract for the construction of a 1-story, 200x300-ft. factory on 23rd St. and the Lake Erie Western R.R. to John G. Karstedt Constr. Co., 429 Lemcke Bldg. Estimated cost, $200,000.

INDIANAPOLIS — The Pioneer Brass Wks., 424 South Pennsylvania St., plans to install new foundries and equipment in the proposed plant here.

INDIANAPOLIS — The United States Fiber Box Co., Martindale and Roosevelt Aves., is having preliminary plans prepared for the construction of a 4-story, 100x160-ft. factory on Martindale Ave. Estimated cost, $125,000. Charles E. Bacon, 617 Merchants Bank Bldg., archt.

INDIANAPOLIS — The Universal Slag Brick & Tile Co., Gary, Ind., is in the market for $50,000 worth of machinery for use in plant including all machinery used in making tile and brick.

WEST HAMMOND—The La Salle Iron Works, 2305 South Halsted St., Chicago, has awarded the contract for the construction of a steel plant including seven 1-story buildings, to the Broline Nolan Co., 8 South Dearborn St., at $650,000.

Iowa

CUSHING—A. H. Bullock, Secy. of the Bd. of Educ., has awarded the contract for the construction of a 3-story, 59x111-ft. school, to W. F. Kucharo & Co., 622 Hubbell Bldg., Des Moines, at $111,444. Chemical laboratories will be installed in same.

LARABEE—H. Montgomery, Secy. has awarded the contract for the construction of a 3-story, 82x139-ft. school, to W. F. Kucharo & Co., 622 Hubbell Bldg., Des Moines, at $124,500. A chemical laboratory will be installed in same.

MORNING SUN—The Bd. Educ. has awarded the contract for the construction of a 2-story, 56x130-ft. school, to the Western Constr. Co., Earlham, La., at $142,400. Chemical laboratories will be installed in same. Noted May 12.

MUSCATINE — The Muscatine Packing Co. has awarded the contract for the construction of a 4-story, 54x64-ft. fertilizer building in connection with the proposed packing plant, to the Federation Constr. Co., 532 Davidson Bldg., Sioux City. Estimated cost, $1,000,000.

PACKWOOD—N. E. Olliver, Secy. of the Bd. Educ., has awarded the contract for the construction of a 2-story, 58x99-ft. school, to W. F. Kucharo & Co., 622 Hubbell Bldg., Des Moines, at $92,980. Chemical laboratories will be installed in same. Noted May 12.

POCAHONTAS—W. J. Gilchrist, Pres. of the School Bd., has awarded the contract for the construction of a 2-story, 56x110-ft. school, to C. E. Larson, Fort Dodge, at $118,000. Chemical laboratories will be installed in same. Noted June 16.

Louisiana

NEW ORLEANS—The Prest-O-Lite Co., 30 East 42nd St., New York City, has purchased a site on Anthony and St. Louis Sts., for the construction of a 2-story acetylene plant.

Massachusetts

CHELSEA — The Walker Bros. Dyeing & Bleaching Co., Clinton St., plans to rebuild bleachery recently destroyed by fire. Estimated cost, $50,000.

FALL RIVER—The New England Oil Co. will build a 1-story, 17x25-ft. oil receiver house, 32x74-ft. oil condensers and 45x181-ft. oil stills, etc., along the Taunton River here. Estimated cost, $100,000. Work will be done by day labor.

HOLYOKE — The New England Tire & Rubber Co., 285 High St., has awarded the contract for the construction of a 3-story, 110x210-ft. factory on Main St., to the Casper Ranger Constr. Co., 20 Bond St. Estimated cost, $350,000.

SPRINGFIELD—The Buckley Fdry Co., 13½ Cypress St., has awarded the contract for the construction of a 1-story, 85x100-ft. foundry on Roseland St., to J. G. Roy & Sons Co., 21 Silver St., at $8,600.

Michigan

BAY CITY—The city is having preliminary plans prepared for the construction of a filtration plant, etc., in connection with the proposed waterworks improvements. Estimated cost, $2,000,000. Frazier-Elms-Shael Co., 1223 Illuminating Bldg., Cleveland, O., engrs.

DETROIT — The Michigan Grey Iron Casting Co., Harbaugh Ave., plans to build a 1-story foundry addition on Harbaugh Ave. and the Wabash Ry. Estimated cost, $40,000. F. J. Winter, 2331 Dime Bank Bldg., archt.

Minnesota

COLERAINE — The Indian School Dist. 2, Itasca Co., has awarded the contract for the construction of a 2-story, 176x208-ft. high school, to Evenson & Utterberg, 552 Builders' Exch., Minneapolis, at $455,000. A chemical laboratory will be installed in same. Noted June 9.

MINNEAPOLIS—The State Bd. of Control, Capitol, St. Paul, will soon award the contract for the construction of a 3-story, 80x110-ft. chemistry building on the State University campus here. Estimated cost, $200,000. C. H. Johnston, 716 Capital Bank Bldg., St. Paul, archt.

Missouri

ST. LOUIS—The St. Louis Surfacer Paint Co., 5432 Hazel Ave., has awarded the contract for a 2-story, 40x64-ft. manufacturing building on Hazel Ave., to George L. Cousins & Co., Chemical Bldg. Estimated cost, $30,000.

New York

MARCY — The State Hospital Comn., Capitol, Albany, will receive bids until Aug. 25 for the construction of a mechanical gravity filtration plant, etc., for the Utica State Hospital here. Noted July 7.

TONAWANDA — The city has awarded the contract for the construction of a filtration plant, to the Roberts Filtration Co., Philadelphia, Pa., at $200,000. Noted April 14.

North Dakota

GRAND FORKS—The Industrial Comn. of North Dakota has awarded the contract for the construction of a reservoir and filter plant, etc., to the Fegles Constr. Co., Minneapolis. Noted May 19.

Ohio

CANTON—The Canton Drop Forge Co., 300-400 Odd Row Pl., S.E., plans to build a 1-story, 95x100-ft. factory on Willet Ave., S.E. Estimated cost, $45,000. C. E. Firestone, Renkert Bldg., archt.

GLENMONT—The Bd. Educ. has awarded the contract for the construction of a grade and high school here, to the State Constr. Co., 11 State St., Columbus. A chemical laboratory will be installed in same. Estimated cost, $80,000.

IRONTON—The Bd. Educ. is having plans prepared for the construction of a high school here. A chemical laboratory will be installed in same. Estimated cost, $600,000. F. L. Packard, Hayden Bldg., 16 East Broad St., Columbus, archt.

KENTON—The Bd. Educ. plans to construct a high school here. A chemical laboratory will probably be installed in same. Richards, McCarty & Bulford, 1504 East Broad St., Columbus, archts.

MIAMISBURG—The Bd. Educ. is having plans prepared for the construction of a 2-story, 120x140-ft. high school. A chemical laboratory will be installed in same. Estimated cost, $200,000. F. L. Packard, New Hayden Bldg., archt.

MIDDLETOWN—The Advance Bag Co., 155 North B'way, has awarded the contract for the construction of a 3-story, 65x300-ft. paper factory, to J. R. Stevens, Odd Fellows Temple, Cincinnati, at $150,000.

SOUTH EUCLID—The Bd. Educ. will soon award the contract for the installation of septic and filter tanks in the streets adjoining the Victory Park School. Estimated cost, $25,000. W. H. Nichlas, 1900 Euclid Ave., Cleveland, engr.

WARREN—The Bd. Educ., c/o J. Buckwalter, received bids for the construction of a 2-story, 110x182-ft. school addition to the West Technical High School, from the Shustrump Co., Youngstown, $329,869; for a 2-story, 125x150-ft. school addition to the East Technical High School, $322,212. Laboratory equipment will be installed.

Pennsylvania

CEDAR GROVE (Philadelphia P. O.)—J. F. Stokes, 17th and Cambria Sts., has awarded the contract for the construction of a 1-story plant for the manufacture of chemical machinery, to John N. Gill, Otis Bldg., Philadelphia.

DERRY—The Pittsburgh High Voltage Insulator Co. plans to improve and enlarge its plant here. Plans include a 101x244-ft. building which will be equipped with new clay mixing machinery. Estimated cost, $150,000.

SCRANTON—The Bour Refractories Co., Laurel Line and Front St., plans to build a 3-story, 90x200 ft. refractory addition on Stafford Ave. Estimated cost, $300,000.

Rhode Island

PROVIDENCE—The Franklin Process Co, 29 Promenade St, will soon award the contract for the construction of a 2-story, 110x175-ft, dye house. Estimated cost, $150,000. Lockwood, Greene & Co., 60 Federal St., Boston, archts. and engrs.

Tennessee

MEMPHIS—The Fly Shot Co., Nashville, Ga., has purchased a site on Dowa Ave. and 4th St., and plans to construct a 2-story, 50x150-ft. insecticide factory on same. Estimated cost, about $100,000.

Virginia

AUSTINVILLE—The Bertha Mineral Co. will build a mining, milling and smelting plant. Work will be done by day labor.

NORFOLK—The city is having plans prepared for the construction of a water plant. A filtration system will be installed in same. Estimated cost, $4,000,000. W. H. Taylor, Dir. of Pub. Wks.

ROANOKE—The Greenstone Products Co. Inc. plans to build a slate granite plant to have a daily capacity of 1,000 tons. L. P. Costy, secy. and treas.

West Virginia

SHINNSTON CITY—The city plans to build a 100,000-gal. filtration plant. Estimated cost, $75,000.

Wisconsin

MERTON—The Merton Dairy Products Co. is having plans prepared for the construction of a 1-story, 45x70-ft. addition. Estimated cost, $35,000. Laboratory equipment will be installed in same. M. Tullgrén & Sons, 425 E. Water St., Milwaukee, archt.

MILWAUKEE—The Badger Brass Co., 243 Lake St., is in the market for brass foundry equipment.

MILWAUKEE—Milwaukee County plans to build an 8- and 6-story hospital on Grand Ave. Chemical laboratories will be installed in same. Estimated cost, $2,000,000. Van Ryn & DeGelleke, Caswell Blk., archts.

MILWAUKEE—St. Mary's Hospital, 448 Lake Drive, plans to build an addition to a hospital. A chemical laboratory will be installed in same. Estimated cost, $200,000.

NEENAH—The Theda Clark Hospital has awarded the contract for the construction of a 2-story, 40x100-ft. hospital addition, to C. R. Meyer & Son, 50 State St., Oshkosh. A chemical laboratory will be installed in same. Estimated cost, $75,000.

WAUKESHA—The Waukesha Casting Co. has awarded the steel contract for a 120x130-ft. foundry, to the Federal Bridge Co., at $50,000. Noted July 14.

Ontario

FORT WILLIAM—The Fort William Pulp & Paper Co. has awarded the contract for the construction of a 2-story, 400x600-ft. pulp and paper mill at the mouth of the Mission River, to the Barnett McQueen Co., at $1,800,000. Noted July 21.

TORONTO—The Grinnell Co. Ltd. has awarded the contract for the construction of a 1-story, 100x150-ft. foundry building to the Anglin Norcross Co. Ltd.

Coming Meetings and Events

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE will hold its 1920 meeting Dec. 27, 1920, to Jan. 1, 1921, at Chicago, Illinois.

AMERICAN CERAMIC SOCIETY will hold its summer meeting at the La Salle Hotel in Chicago, Aug. 16, 17 and 18.

AMERICAN CHEMICAL SOCIETY will hold its fall meeting in Chicago, Sept. 7 to 10 inclusive.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in the Hotel Statler, Cleveland, Ohio, Sept. 30, Oct. 1 and 2.

AMERICAN FOUNDRYMEN'S ASSOCIATION will meet in Columbus, Ohio, Oct. 4 to 8 inclusive.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its one hundred and twenty-second meeting Aug. 20 to Sept. 3, at Lake Superior.

AMERICAN MINING CONGRESS will hold its next convention in Denver Nov. 15.

AMERICAN PHYSICAL SOCIETY will hold a meeting Nov. 27 at the Case School of Applied Science, Cleveland, and the annual meeting, beginning Dec. 28, at Chicago, the latter being the occasion of the special quadrennial meeting of the American Association for the Advancement of Science and the Affiliated Societies.

AMERICAN STEEL TREATERS' SOCIETY, Chicago, will hold its second annual convention and exhibit, combined with the convention of the Steel Treating Research Society of Detroit, Mich., in the Coliseum Museum, Philadelphia, Pa., Sept. 14 to 18 inclusive.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS will hold its 14th annual convention at the Hotel Pennsylvania, New York City, Sept. 20 to 24, 1920.

ENGINEERING COUNCIL will hold its next meeting in Chicago, Thursday, Oct. 21, 1920.

INSTITUTE OF METALS DIVISION OF THE A.I.M.E. will hold its usual joint meeting with the American Foundrymen's Association at Columbus, Ohio, during the week beginning Oct. 4.

IRON AND STEEL INSTITUTE (British) will holds its autumn meeting at Cardiff by invitation of the Ironmasters and Steel Manufacturers of South Wales and Monmouthshire. The date of the meeting will be Tuesday, Sept. 21, for the assembling of the members at Cardiff, and the formal proceedings will open on the morning of Wednesday, Sept. 22.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (SIXTH) will be held in the Grand Central Palace, New York City, Sept. 20 to 25.

SOCIETY OF INDUSTRIAL ENGINEERS will hold its fall national convention at Carnegie Music Hall, Pittsburgh, Pa., Nov. 10, 11 and 12, 1920.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY will hold its fall meeting at Saratoga Springs, N. Y., Sept. 1, 2 and 3.

Industrial Notes

DEWEY, STRONG & TOWNSEND, patent attorneys, announce the entry of Capt. W. A. Loftus and Thomas Castberg, J. A. Abbett and J. H. Herring into the firm, which will be known as Dewey, Strong, Townsend & Loftus. Mr. Abbett will specialize in chemical and electrical patent matters and Mr. Castberg will devote his attention to engineering and industrial patent cases. The offices will remain in the Crocker Bldg., San Francisco.

THE MOLYBDENUM CORP. OF AMERICA, Empire Bldg., Pittsburgh, Pa., having the same executive and operative personnel as that of the Electric Reduction Co., announces that it has acquired as of July 1, 1920, the plant, equipment and operations of the Electric Reduction Co. at Washington, Pa., together with extensive molybdenum mines in New Mexico. This company will continue to furnish ferrotungsten, ferromolybdenum and other high grade ferro-alloys, metals and chemical products as heretofore furnished by the Electric Reduction Co., with no change in policy whatever. Having now direct control from the crude ore to the finished material the Molybdenum Corp. of America is in position to render exceptional service in supplying molybdenum products.

THE GLIDDEN CO., Cleveland, O., uses in its sixteen paint and varnish plants a tremendous quantity of lithopone. With a view to insuring a uniform supply of this important commodity it has acquired the St. Helena lithopone plant of the Chemical Pigments Corp. The capacity of the plant will be increased to meet the needs of the Glidden Co. The present staff will be maintained and augmented. The business will be operated under the name of the Glidden Co. Lithopone Department.

THE AMERICAN METALLURGICAL CORP., Philadelphia, which was the controlling factor of the Philadelphia Electric Steel Corp., announces the reorganization of that company's affairs along the following lines: E. C. Hummel, who has been the electric steel foundry superintendent at the United Alloy Steel Corp., Canton, Ohio, has purchased a controlling interest and has reincorporated the company, which will be known as the Philadelphia Electric Steel Castings Co. The new directors and officers of the corporation will be: E. C. Hummel, president and general manager; F. J. Ryan, vice-president and treasurer (Mr. Ryan is also president of the American Metallurgical Corp.); F. H. Schrenk, secretary (Mr. Schrenk is also the attorney for the American Metallurgical Corp.) C. T. Hess, director (Mr. Hess is vice-president of the E. P. Wilbur Trust Co., Bethlehem, Pa.); R. V. Mitchell, director (Mr. Mitchell is the manager and secretary of the United Securities Co., Canton, Ohio). The American Metallurgical Corp. retains a 40 per cent interest in the new corporation. Operation under the new management commenced on July 9 and it is the intention of the new controlling factors to enlarge the plant considerably as soon as production has been reached through the present equipment. The furnace capacity has already been doubled. The plant will manufacture high-grade steel castings in addition to special alloy heats, especially catering to instrument and automobile concerns. At the beginning the product will be entirely castings, but later the plant will be enlarged in order to take care of production of small blooms for forgings. This work will all be taken care of through high-speed tool steel.

THE INDIANA INDESTRUCTIBLE PAINT CO. has moved to a new location at 1247 Belmont Ave., Chicago. The new quarters consist of a four-story factory 50 x 125 ft.

Manufacturers' Catalogs

C. F. PEASE CO., 813 North Franklin St., Chicago, Ill., has issued its new catalog No. F-20, called "Drafting Room Practice."

BRIGGS & TURIVAS, INC., 1309 Westminster Bldg., Chicago, Ill., has issued a new publication entitled "Classified Scrap Iron." It is a very valuable little handbook for those who are interested in either the sale or purchase of scrap metal.

NORTON CO., Worcester, Mass., has issued three little booklets, entitled: "The Balancing of Grinding Wheels for Norton Precision Grinding Machines," "Norton Grinding Wheels on the Blanchard Surface Grinding Machines," and "Commercial Diamonds for Truing Grinding Wheels."

LEA-COURTENAY CO., Newark, N. J., has issued a little booklet on "Typical Examples of Lea-Courtenay Centrifugal Pumping Machinery" known as Bulletin S-5, which illustrates and describes a few of its different types of centrifugal pumping machinery.

THE GRISCOM-RUSSELL CO., 90 West St., New York, has just received from the press Bull. No. 1010, on G-R Expansion Joint, Low Pressure.

THE ESTERLINE CO., Indianapolis, Ind., desires to announce Bull. No. 395, covering power factor recording instruments. In this bulletin are pointed out the evils of low power factor to the central station, the isolated plant and the power customer, as well as how to locate and eliminate the causes of low power factor. Copies can be secured upon request.

THE FULLER ENGINEERING CO., Allentown, Pa., is distributing Bull. No. 300, on Metallurgical Furnaces, Annealing and Heat-Treating. The furnaces illustrated and described are representative of the types this company build, including the use of pulverized coal, oil or gas as fuel.

BAUSCH & LOMB OPTICAL CO., Rochester, N. Y., calls attention to a new bulletin on Metallographic Equipment.